User Reference Manual

AX-201

Software release - 2.0

PHILIPS

Assembléon

Integrated electronics manufacturing solutions

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User Reference Manual

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CHAPTER 1 General machine information

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1.1 Front side items

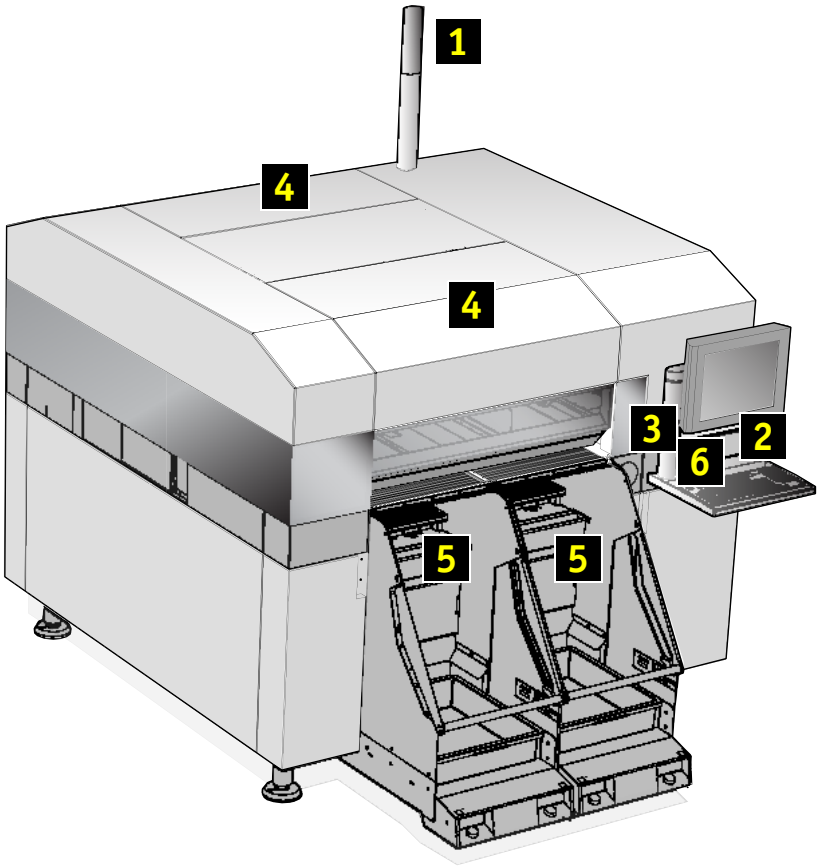

Figure 1 Front side

1. Lamp post, showing the machine status:
   Green, machine in processing mode.
   Blue, machine in error mode.
   White, machine in maintenance mode or idle mode.
2. Keyboard and touch screen.
3. Emergency stop button.
4. Protective cover front and rear.
5. Feeder trolleys.
6. Start button (PA 2410/00 only).

1.2 Rear side items

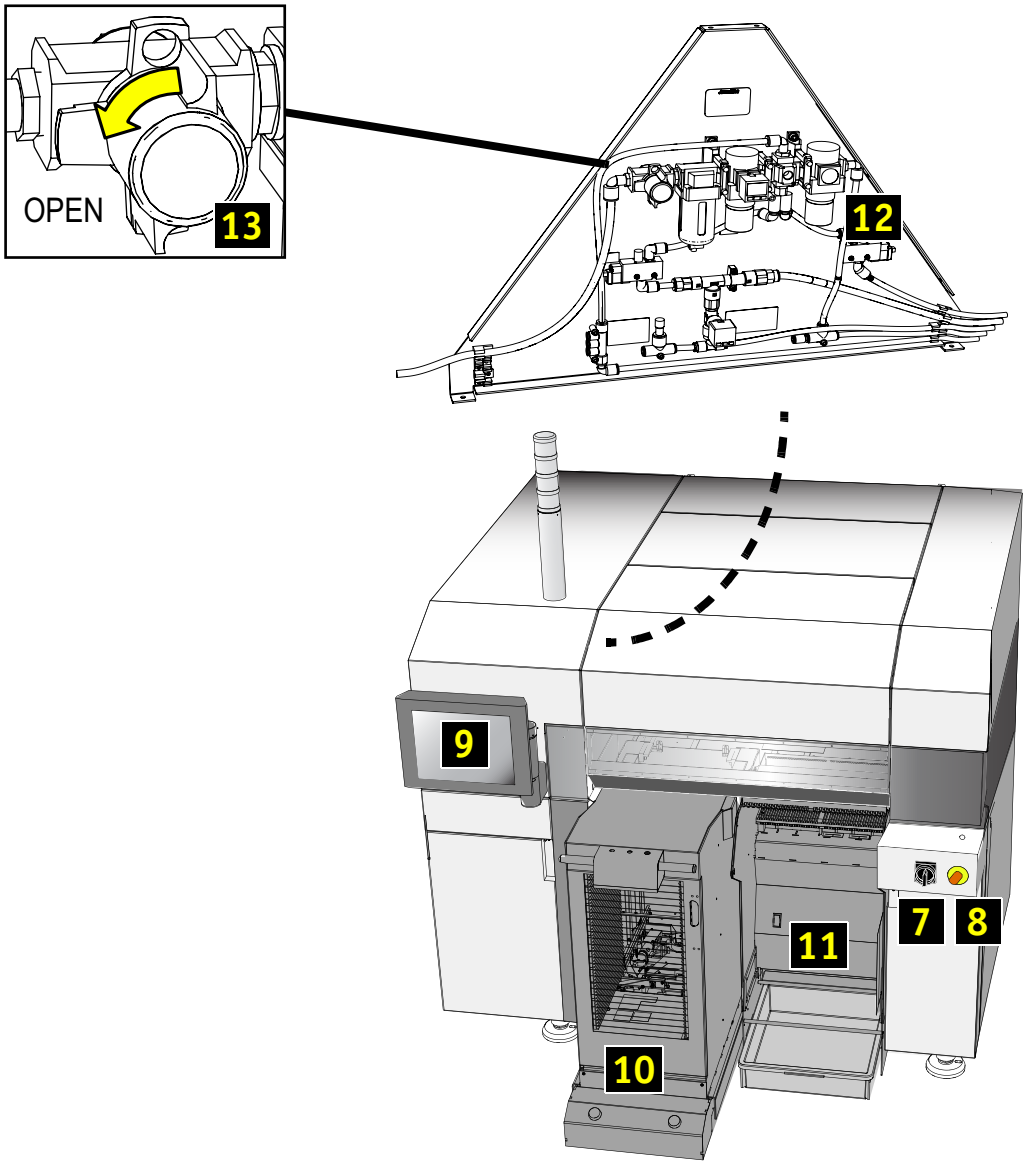

Figure 2 Rear side

7. Main switch.
8. Emergency stop button.
9. Touch screen rear (optional).
10. Tray trolley.
11. Feeder bank.
12. Air supply unit.
13. Air main switch.

1.3 Board transport

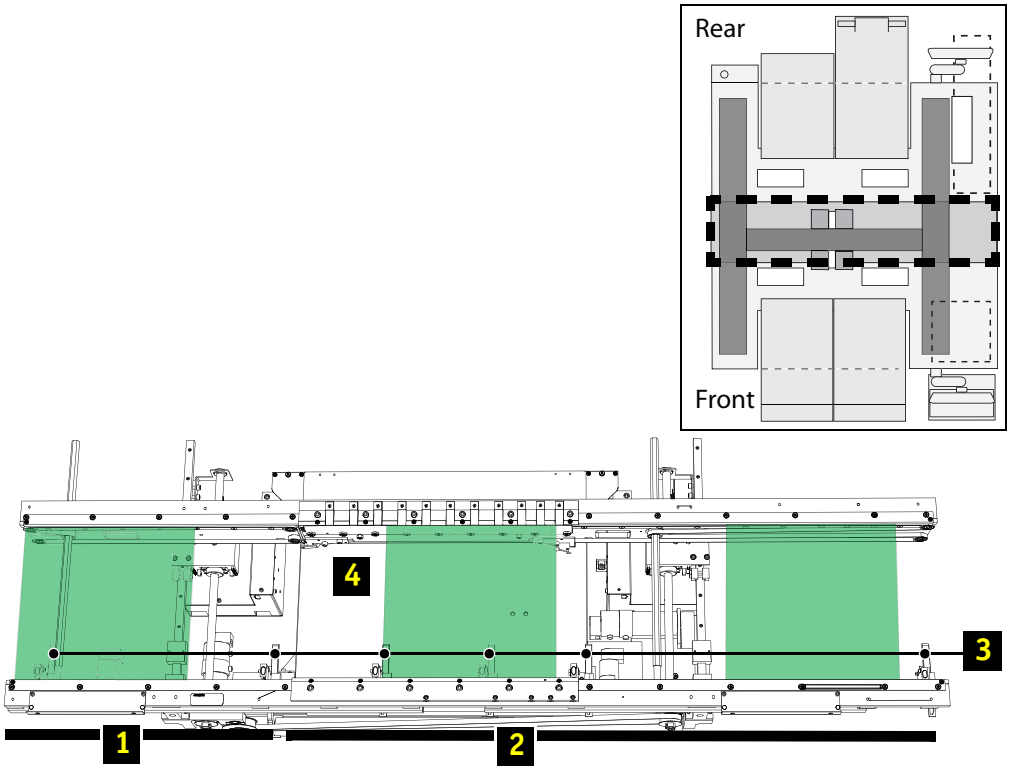

Figure 3 Board transport

The board transport moves the boards through the machine.

1. Run-in section.
2. Work area / run-out.
3. Board sensors.
4. Lift table with board clamping mechanism and board support pins.

1.4 Pick and place

Main function of the placement heads is to pick and place SMD components. The placement heads are moved in X and Y direction via the XY robot.

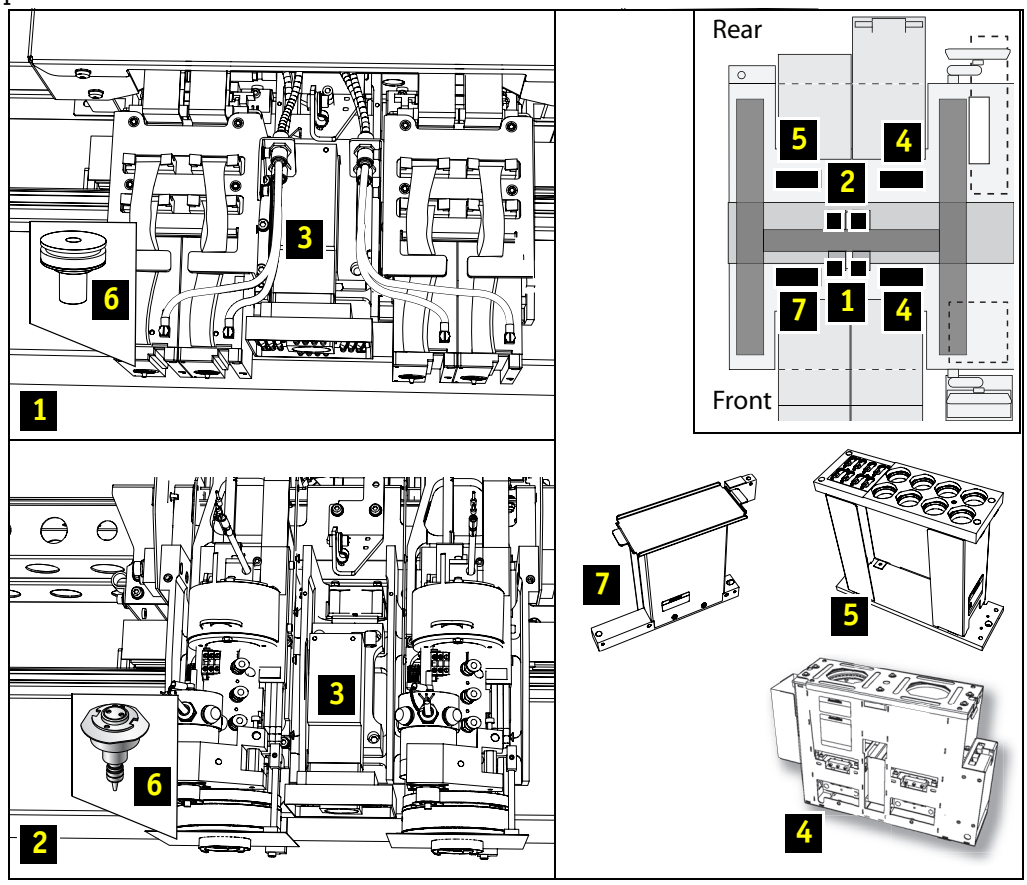

Figure 4 Pick and place

1. Placement heads DV (dual vision).
2. Placement heads HA (high accuracy).
3. BA (board alignment) camera, determining the position of the placement head related to the board and trolley.
4. CV (component vision) camera, measuring the actual position of the component when picked and the shape of a component.
5. Toolbit exchange unit, for unused toolbits
6. Toolbits.
7. Reuse station, for rejected components that are too valuable to waste and might be repaired.

1.5 Graphical user interface (GUI)

The machine is operated via the touch screen. By touching the screen the desired function can be activated. No keyboard is necessary. The keyboard, located in the base under the touch screen, is mainly for service purposes.

1.5.1 Conventions

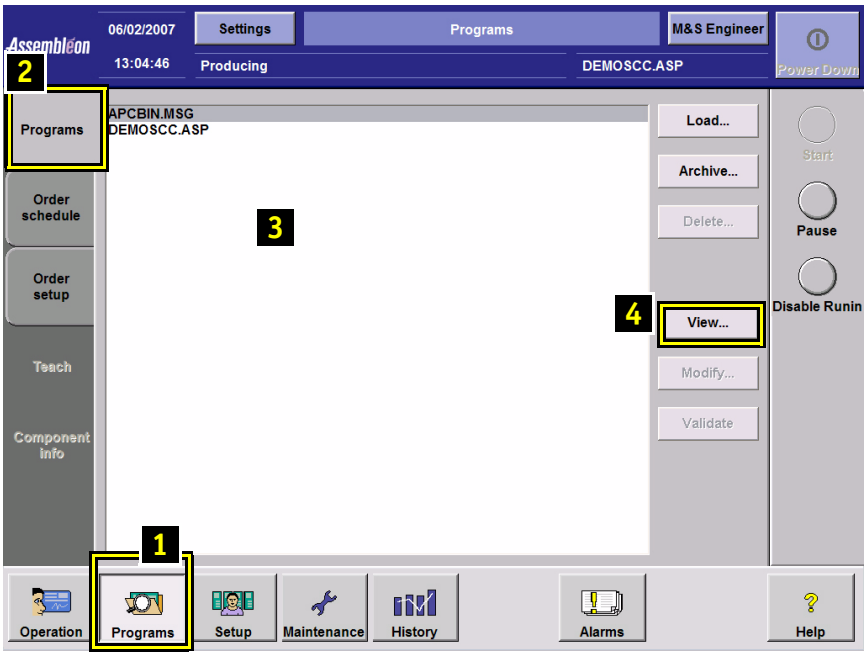

Figure 5 Touch screen

Activating a button on the touch screen is indicated by a circle in this manual. If more than one button has to be activated, the sequence is shown by numbers.

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1.5.2 Touch screen lay-out

The screen is divided into the following panels:

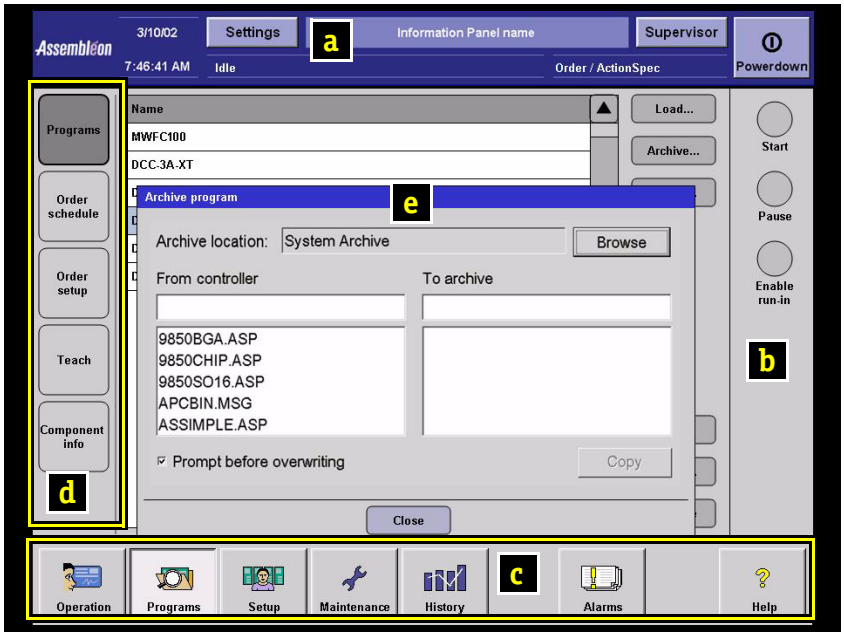

Figure 6 Touch screen, lay-out

a) Title panel: Shows general information of the system.

b) Command panel: Contains main buttons to start or stop the production.

c) Navigation panel: Is used to switch between the different functional environments of the graphical user interface.

d) Sub navigation panel: Is used to switch between the available information panels within one functional environment.

e) Information panel: Shows all information that belongs to a selected function.

CHAPTER 2 Machine description

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2.1 Machine introduction

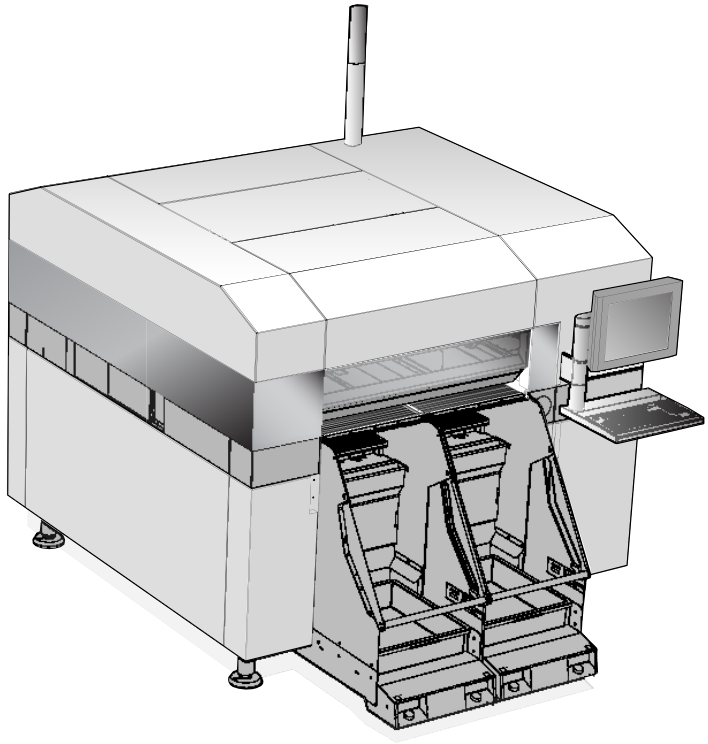

Figure 7 AX-201

The machine is designed for picking and placing very fine pitch and odd components. The machine can be used either as a stand-alone machine or as part of a flow-line. For large - fine pitch - components, special care has been taken in order to obtain the required accuracy. A vision system is used for all types of components (including odd components) to provide correction measurement at board and component level.

Flexibility in production environments is required by families of boards but decreasing order sizes are becoming more important. The machine is especially designed for fast and highly automated change-over between boards with different dimensions and/or different machine set-up requirements.

2.1.1 Main sub-systems

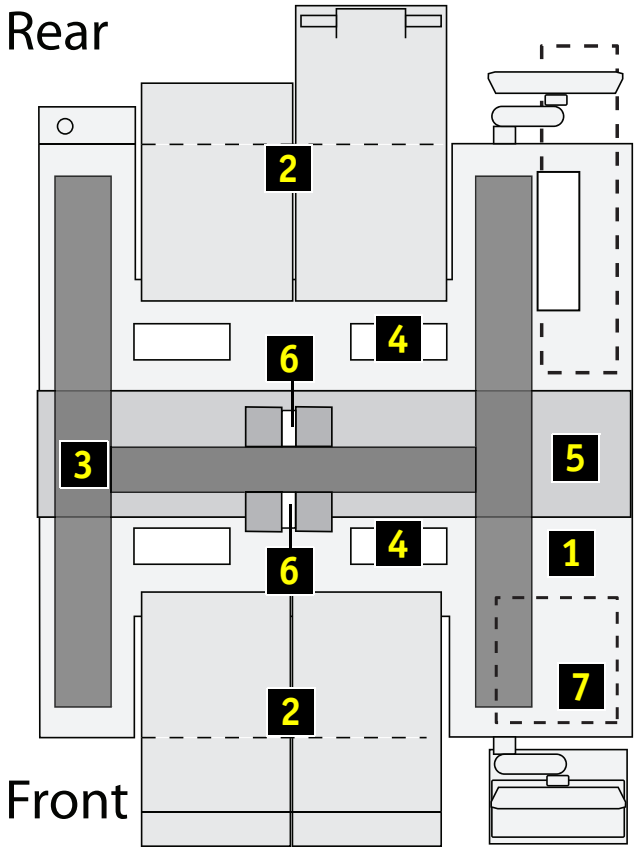

Figure 8 AX-201 schematic top view, location of sub-systems

The machine consists of the following sub-systems:

1. Machine base, see 2.2.1.Machine base
2. Component feeding, see 2.2.2.Component feeding
3. Component transport, see 2.2.3.Component transport
4. Component vision, see 2.2.4.Component vision
5. Board transport, see 2.2.5.Board transport
6. Board vision, see 2.2.6.Board alignment
7. Machine control, see 2.2.7.Machine control

The machine base provides a stable support for all sub-systems. It has four adjustable feet.

Components can be fed to the machine both from the front and the rear. Small components are commonly fed with feeders, large components with trays. For feeders the customer can choose between a trolley and a bank. The machine can support up to four trolleys or banks, two at each side of the machine.

Components are picked from the feeding areas by placement heads that use pneumatic nozzles. The machine can be equipped with two different heads, depending on customer requirements: placement heads DV and placement heads HA. Placement heads HA are typically used to pick and place critical large components. Placement heads DV are typically used to pick and place small components.

The component transport system further consists of an XY robot that can move the placement heads in any horizontal (X and Y) position. The placement heads themselves have the possibility to rotate (RZ) and to move the component in

vertical (Z) direction. By this combination of movements the machine can pick components from the feeding areas and transport them to the work area, where they are placed on a board.

Between picking and placing the component, every component is measured, using a Component Alignment (CA) Camera. The component transport system keeps the component above the Component Alignment (CA) Camera, while an image is taken from the component. The system recognizes the shape of the component and uses the measurement results for accurate placement.

Another important factor in placement accuracy is the position of the board. Boards are transported trough the machine by the board transport system. Boards can enter the machine both on the left and the right side of the machine. Board transport belts move the board to the centre of the machine, where components can be placed. When the board is in the correct position a board vision system is used to measure the exact position of fiducial marks on the board. This ensures correct placement of components on the board.

The machine control system controls all processes. The two main controllers, the system controller and the process controller, are located at the right front side of the machine.

2.1.2 Pick and place process

The system places components on a printed circuit board. In general steps:

1. The machine receives a board from an incoming factory transport system.
2. The board is positioned in the centre of the transport system, the so called work area.
3. Components are picked up from the feeders or trays. This is done by placement heads that are moved by the XY robot.
4. Components are measured by component alignment cameras, located on the base. Form, size and position of the components are checked. At the same time a board alignment camera, located between the placement heads, checks the position of the placement heads with respect to the component alignment camera.
5. After measurement, the components are moved to the work area.
6. At the work area the position of the board is measured with a BA (board alignment) camera. The board has fiducial marks for accurate position recognition.
7. When both the position of the board and the components are known, the components are placed on the board.
8. Steps 3 to 7 are repeated until all necessary components are placed. In the meantime the next board is waiting in the transport run in area for the whole process to be repeated.
9. The placement process is described by a placement program.
   Placement programs are generated by PPS, and describe the required machine configuration and set-up, with the actions to be performed, to process a board.

2.2 Module description

This chapter describes the functionality of the main sub-systems mentioned in chapter 2.1.1.Main sub-systems

2.2.1 Machine base

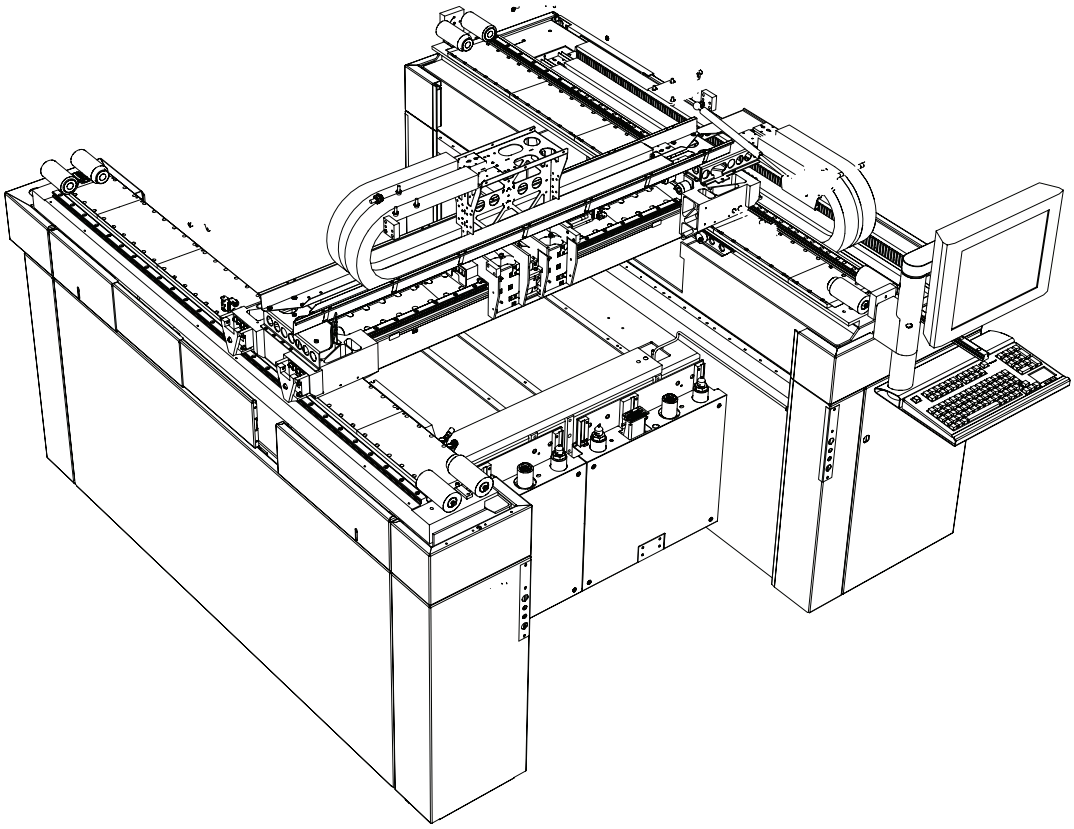

Figure 9 Machine base AX-201

The machine base consists of:

- A H-shaped frame, made of welded standard rectangular steel plates. The frame is rigid and heavy to minimize vibration transfer from the shop-floor to the machine and provides a stable support for XY robot.
  The base is height adjustable to comply with SMEMA standards.
- The mechanical interface surfaces for connection of the XY robot, board transport and trolley lifts.
- The cabinet with the control and supply systems including the safety covers and doors provides safe working conditions for the operator.

2.2.2 Component feeding

Component feeding is built up from the following main sub-assemblies:

- Trolley lift.
  This is an interface between the base and the trolley, that can move:
  - Up, when a trolley is connected to the machine
  - Down, when a trolley is exchanged or removed from the machine
- Feeding options:
  - Feeder trolley
  - Feeder bank
  - Tray trolley
- Feeders and trays that contain the components.

The feeding sections communicate with the process controller.

2.2.2.1 Trolley lift

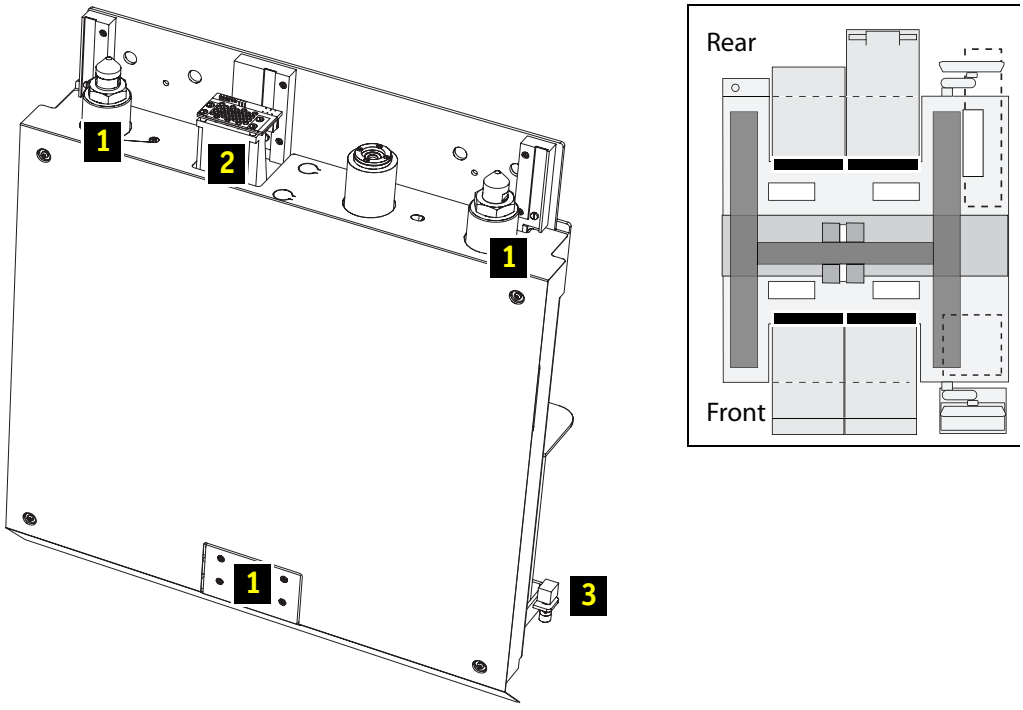

Figure 10 Trolley lift

The trolley lift is mounted on the base, and consists of the following main parts:

- Three mechanical interface points (1).
- An electrical interface (2).
- A service switch (3), to lower the trolley lift in case of a malfunction.

The trolley lift is operated via the user interface of the trolley or feeder bank. It moves up when connecting a trolley to the machine. To remove a trolley from the machine, the trolley lift moves down.

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2.2.2.2 Trolleys, feeder bank

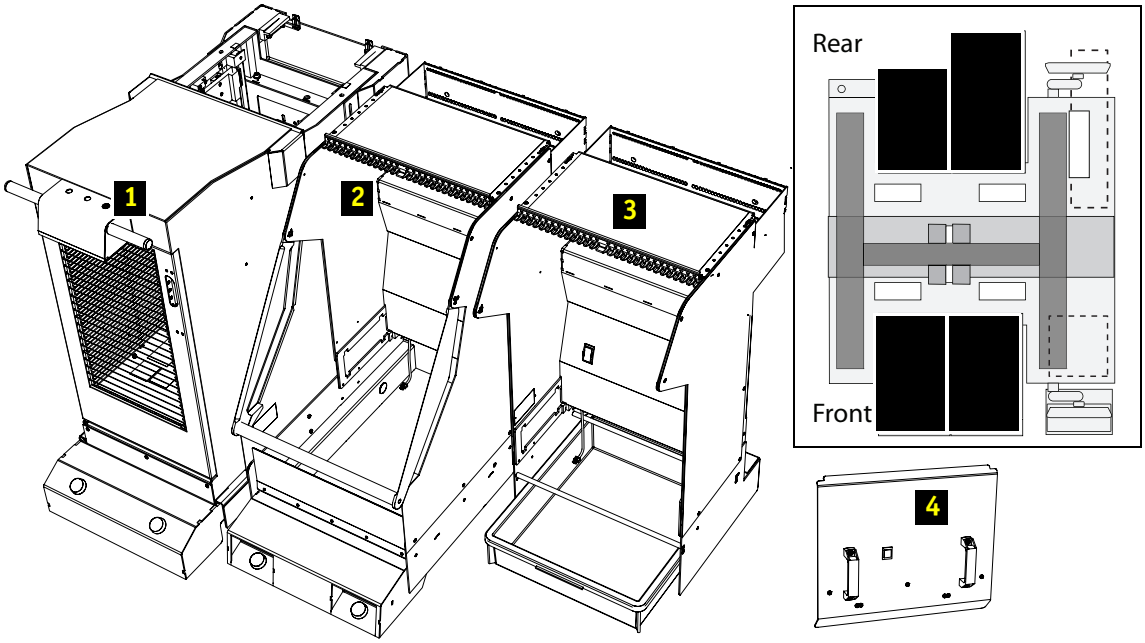

Figure 11 Trolleys and feeder banks

1. Tray trolley
   The tray trolley is connected to the machine by the trolley lift during production. Power and signals are provided to the tray trolley via the electrical interface on the trolley lift. A tray trolley can hold up to 48 trays.
   The tray trolley is operated by foot switches.
2. Feeder trolley
   The feeder trolley is connected to the machine by the trolley lift during production. Power and signals are provided to the feeder trolley via the electrical interface on the trolley lift. A feeder trolley can hold up to 48 feeders of various types. The feeder trolley is operated by foot switches.
3. Feeder bank
   In most cases the feeder bank is permanently connected to the machine. Power and signals are provided to the feeder trolley via the electrical interface on the trolley lift. A feeder bank can hold up to 48 feeders of various types.
   The feeder bank is operated by a switch.
4. Safety cover
   If no trolley or bank is provided, a safety cover must be mounted instead.
   The safety cover is operated by a switch.

Several type of feeders can be mounted on a feeder bank or trolley. The feeder and/or tray trolley can be exchanged including the feeders/trays that it contains.

2.2.2.3 Auxiliary feeding

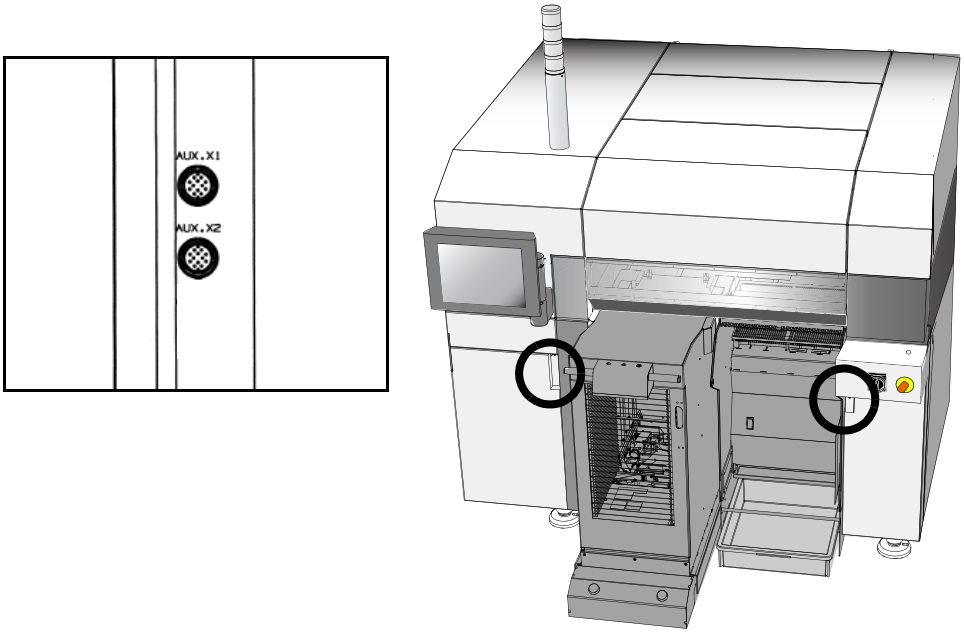

Figure 12 Auxiliary connections

Auxiliary feeder connections are used for not standard Assembléon feeders. Because of the divergent interface of such feeders, power supply and feeder control can be done via this connection.

8 Auxiliary feeder connections are available. Each connection has a restricted amount of positions on the feeder bank for which it can be used. This means that when placing a feeder on the feeder bank only one of the connections can be used.

NOTE: The auxiliary connections are not interchangeable to the other feeder sections, for example the connections left of the feeder section one can only be used for this section.

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2.2.3 Component transport

Components are transported from the feeding sections to the place where they are placed on the board. Horizontal movement (X and Y direction) is done by the XY robot. Vertical movement and rotation is done by the placement heads. The toolbit is an exchangeable part of the placement head that holds the component using vacuum. Various types of toolbits are available. Toolbits suitable for placement heads HA can not be used for placement heads DV and vice versa.

2.2.3.1 XY robot

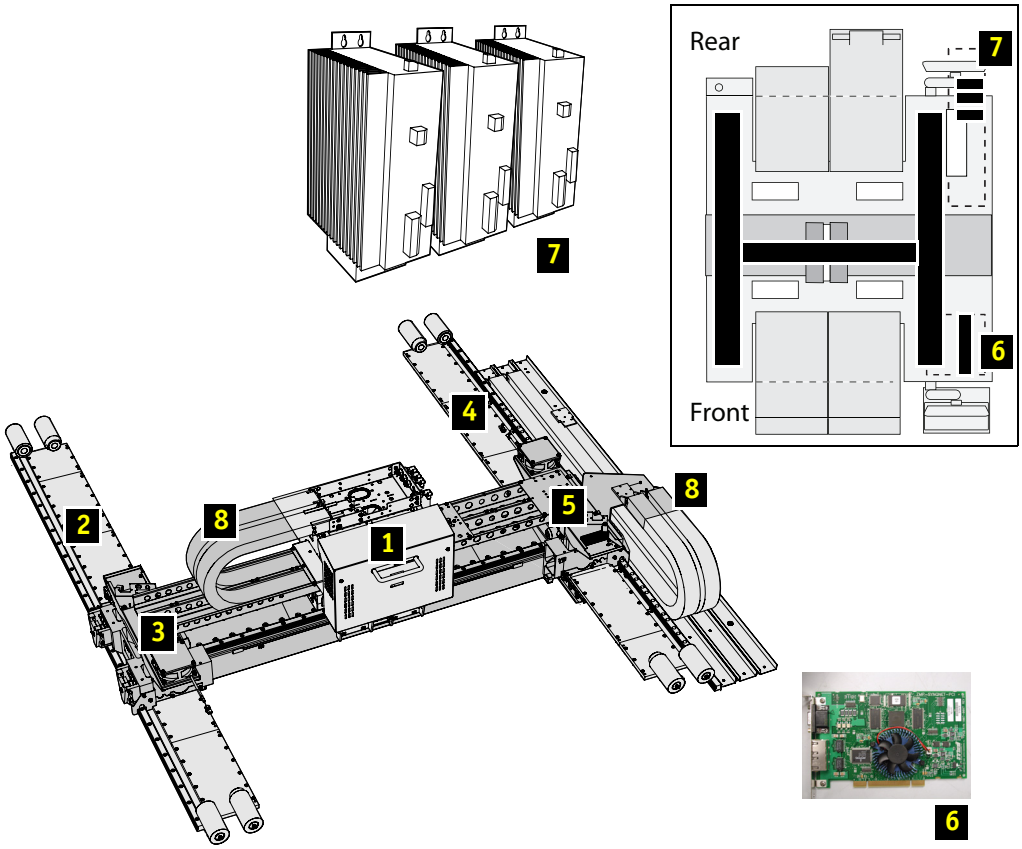

Figure 13 XY robot

Parts overview:

1. X carriage
2. Y1 carriage
3. Y1 linear motor
4. Y2 carriage
5. Y2 linear motor
6. XY controller in process controller
7. Motion amplifiers in control supply unit
8. Cables

The XY robot contains two Y-axes (Y1 at the left, Y2 at the right) and one X-axis, all with linear motors and linear encoders. Each axis has its own controller and power stage, all located inside the electronics cabinet. These controllers are interfaced through a Synqnet network.

2.2.3.2 Placement head HA

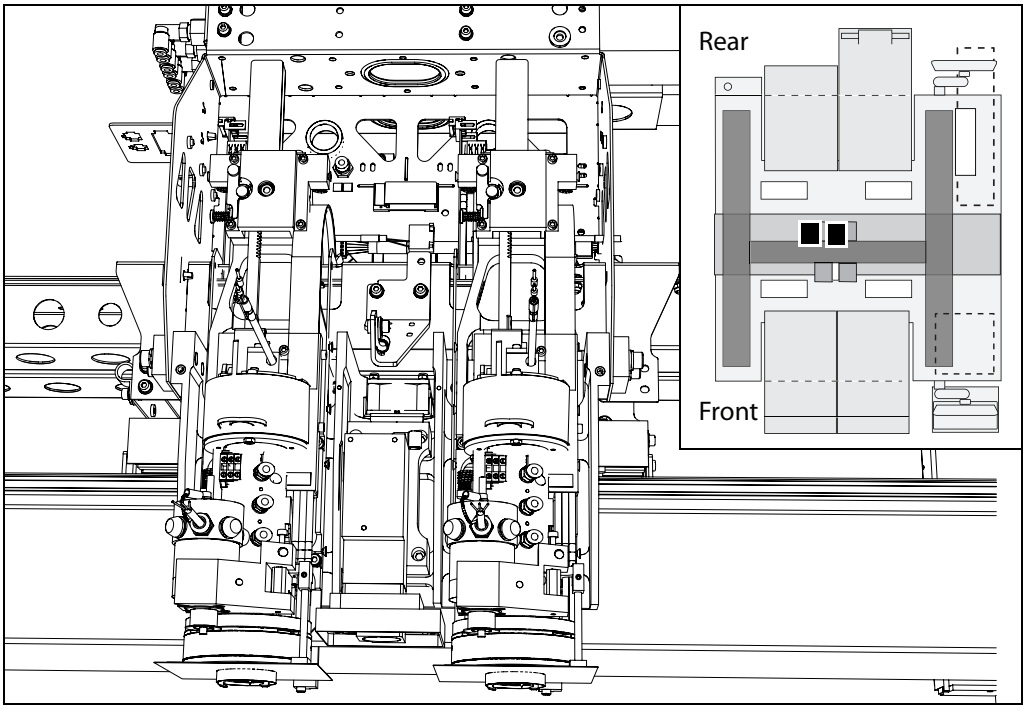

Figure 14 Placement head HA

The placement head HA consists of:

- A servo system for up-down (Z) movement control of the nozzle.
- A servo system for rotation (RZ) alignment of the component.
- A real time force control, allowing components to be pressed to the board with a programmable force.
- A nozzle interface handles telescopic nozzles (in fact 2 nozzles in one that can be automatically selected) for picking several types of components

The nozzle picks the component from the packaging (tape, tray, stick) and holds it while the XY robot moves to the placement position. Component pick-up and detection is done with a vacuum system. The component relative position will be measured by a vision system. After the component is placed on the board, the placement head releases the component.

Each placement head has a controller and the following data apply:

- Pitch between the heads, 153.9 mm.
- RZ rotation control:
  - Max. RZ stroke, infinite
  - Min. step size, 0.0072 degree.
- Real time force control

	Range 1	Range 2	Range 3
Nominal force range	1 N ≤ F ≤ 3,5 N	4 N ≤ F ≤ 14 N	15 N ≤ F ≤ 40 N
Accuracy	F ± 50%	F ± 30%	F ± 20%
Min. step range	see note below	0.5 N	1.0 N

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NOTE: Range 1 is covered by inner nozzles. When inner nozzles are used only one specific force per inner nozzle is possible. These forces are mentioned in the performance specifications of the nozzles. When FC nozzles are used, the force is programmable. The minimum step size is 0.5 N.

- Maximum stroke, 77 mm:
  - Placement force, 4 - 14 N ± 30% (programmable).
  - Absolute accuracy, ± 0.5 N.

2.2.3.3 Placement head DV

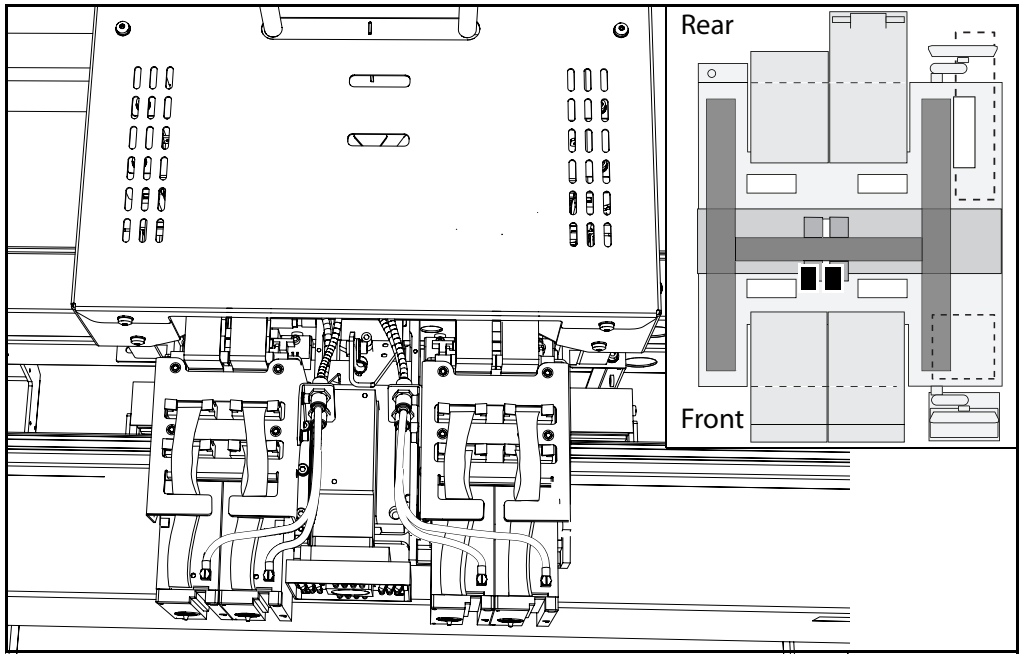

Figure 15 Placement heads DV

The placement heads DV are mounted in pairs on the XY robot.
Each pair can move in Z direction (up-down). This is done by a linear guide, powered by a pneumatic cylinder.

Calibration data is stored in the memory of the placement head itself.

RZ (rotation) and Z movement.

- Linear Z motor, is capable to pick-up and place components with a programmable placement force.
- Rotation is servo controlled, direct driven.
- The Z shaft is equipped with a magnetic interface for easy attachment of toolbits. Vacuum or blower air pressure comes from the pneumatic controller.

2.2.3.4 Toolbit exchange unit

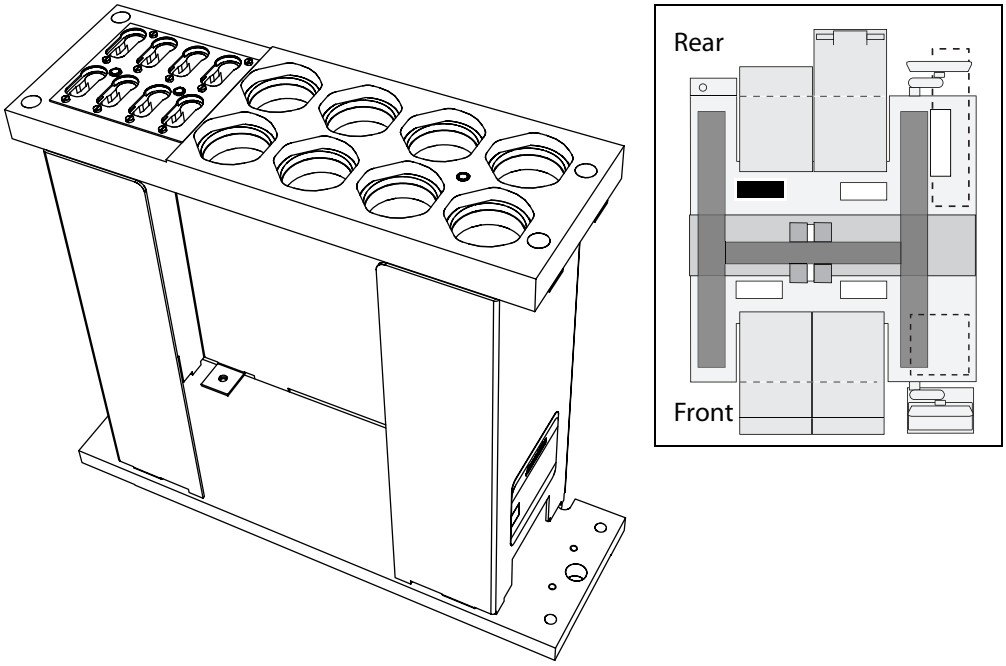

Figure 16 Toolbit exchange unit

In general the machine uses two types of toolbits:

- Toolbits, suitable for the placement head HA.
- Toolbits, suitable for the placement head DV.

Both toolbit types can be stored in the machine in a toolbit exchange unit. The toolbit exchange unit can hold up to 8 toolbits for placement heads DV, and 8 toolbits for placement heads HA.

2.2.3.5 Toolbits on placement heads DV

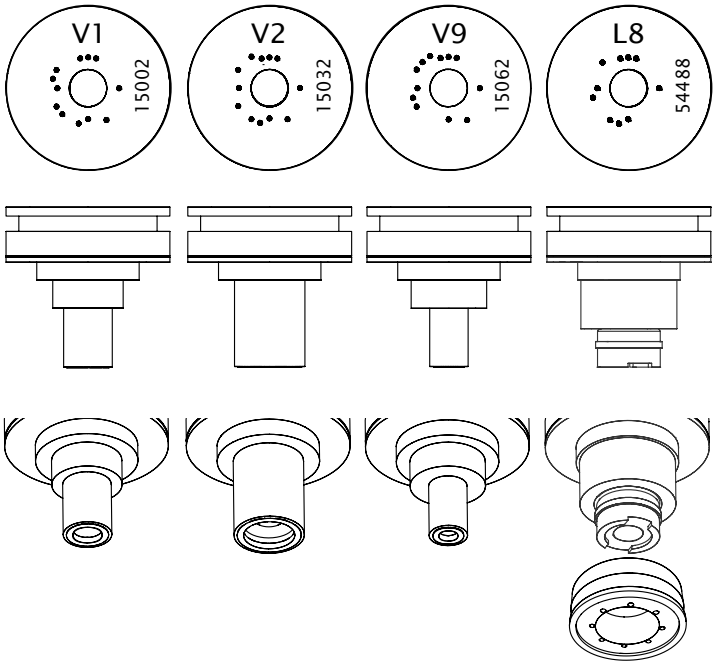

Figure 17 Toolbits survey

Each component is handled with its prescribed toolbit.

Nozzle type	PA	Component range	Component size (mm)	Remarks
V1	2746/10	SO8-SO16L, SSOP20-SSOP28	L= 5-10 W= 5-10	
V2	2746/20	SO16-SO16L SO20-SO28L VS040-VSO56 SOP20-SOP56	L= 6-14 W=6-14	
V9	2771/85	BGA Flip chip	L= 3-5 W= 3-8	
L8	2771/35	BGA SO, SOJ SSOP, TSSOP VSO QFP PLCC	L=10-45 W=10-45	

Figure 18 Toolbits for placement head DV

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2.2.3.6 Toolbits on placement head HA

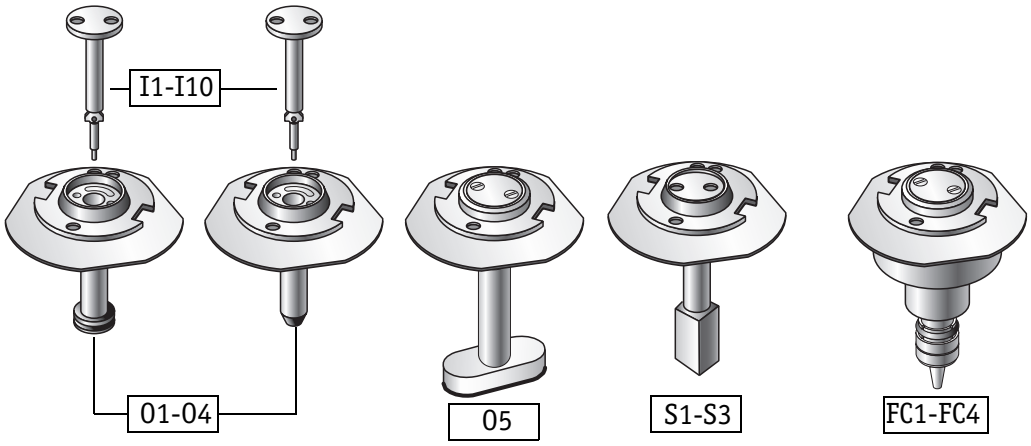

Figure 19 Toolbits for placement heads HA

Nozzle style	Nozzle type	PA	Component range	Component size (mm)		Outer diameter nozzle (mm)
Outer	O1	2744/11	SO8-SO16L SSOP20... SSOP28	L= 5-10	W= 5-10	ø 3.5, with integrated rubber ring
	O2	2744/21	SO16-SO16L SO20-SO28L VSO40-VSO56 SOP20-SOP56	L= 6-14	W= 6-14	ø 5.5 with integrated rubber ring
	O3	2744/30	PLCC20-PLCC68 QFP44-QFP160	L= 10-17.5	W= 10-17.5	ø 9 (V-seal)
	O4	2744/40	PLCC44-PLCC84 QFP120-QFP240	L= 15-45	W= 15-45	ø 14 (V-seal)
Inner	I1	2744/50	0402... 0603	L= 1-1.8	W= 0.5-1	1.3 x 0.9
	I2	2744/60	0603... 2010	L= 1.8-4	W= 0.8-2	1.6 x 1.2
	I3	2744/70	1206-2512 Flip chips	L= 2.2-5	W= 2.2-5	ø 2
	I4	2744/80	Melf, ø 0.9... ø 2.5	L= 2.2-8	W= 0.9-2.5	ø 1.8
	I5	2749/00	Flip chips	1.0 - 1.8		ø 1.1
	I6	2749/10	Flip chips	1.6 - 4.0		ø 1.6
	I10	2749/50	0201- 0402	L= 0.5-1	W= 0.5-1	0.75 x 0.5
Flipchip (cannot contain an inner nozzle)	FC1	2752/00	Flip chips	L= 0.5-1	W= 0.5-1	0.75 x 0.5
	FC2	2752/10	Flip chips	L= 1-2	W= 1-2	ø 1.1
	FC3	2752/20	Flip chips	L= 1.5-4	W= 1.5-4	ø 1.5
	FC4	2752/30	Flip chips	L= 3-8	W= 3-8.	ø 2.8
Odd (cannot contain an inner nozzle)	S1	2749/60	Connectors	L= 10-45	W= 2.5-4.5	10 x 2.2
	S2	2749/62	Small trimmer POZ3AN	L= 3-5	W= 3-8	ø3
	S3	2749/63	TOKO5CCE	Large trimmers and filters		6 x 6 Vacuum circle 4.8, width 0.8
	O5	2749/61	Odd forms	L= 27-45	W= 6.5-45	27 x 7.2, oval with rubber ring

Figure 20 Toolbits for placement heads HA

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2.2.3.7 Gripper on placement head HA

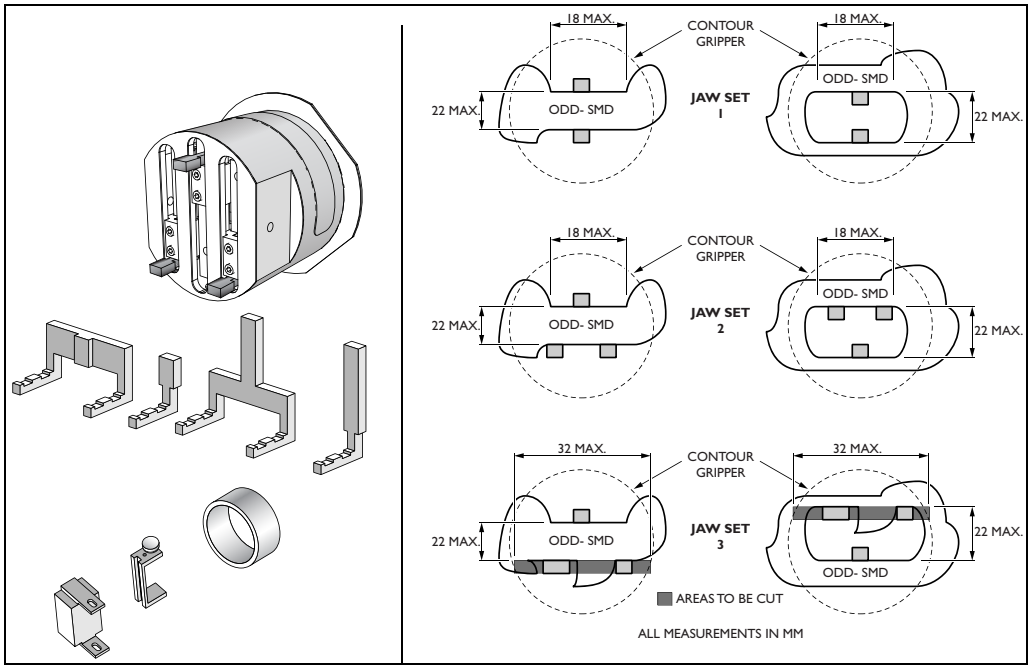

Figure 21 Gripper, overview

Max. component size	165 x 44 mm
Max. component height	50 mm
Max. weight	35 gram
Clamp force	6.5 ± 0.5 N
Placement force	4 – 40 N
Through hole check	4 –14 N

Figure 22 Gripper

Grippers are used to handle components, which cannot be picked by vacuum. Outside-in or inside-out gripping can be selected. The standard gripper set contains a basic gripper with 3 jaw sets.

3 Types of jaw set examples are included with the odd SMD gripper:

- Jaw set 1. Length of the clamping area on the odd-SMD is 18 mm;
- Jaw set 2. Length of the clamping area on the odd-SMD is 18 mm;
- Jaw set 3. Length of the clamping area on the odd-SMD is 32 mm.
  This jaw set is used when the odd-SMD cannot be placed with jaw set 1 or 2 and can be adapted by a small grinding tool or a milling machine to the specific odd-SMD that must be handled.

The machine requires at least one nozzle at machine start-up per HA-side.

NOTE: These outer nozzles can be changed in the toolbit exchange unit after power-up calibration and placement program has started.

2.2.4 Component vision

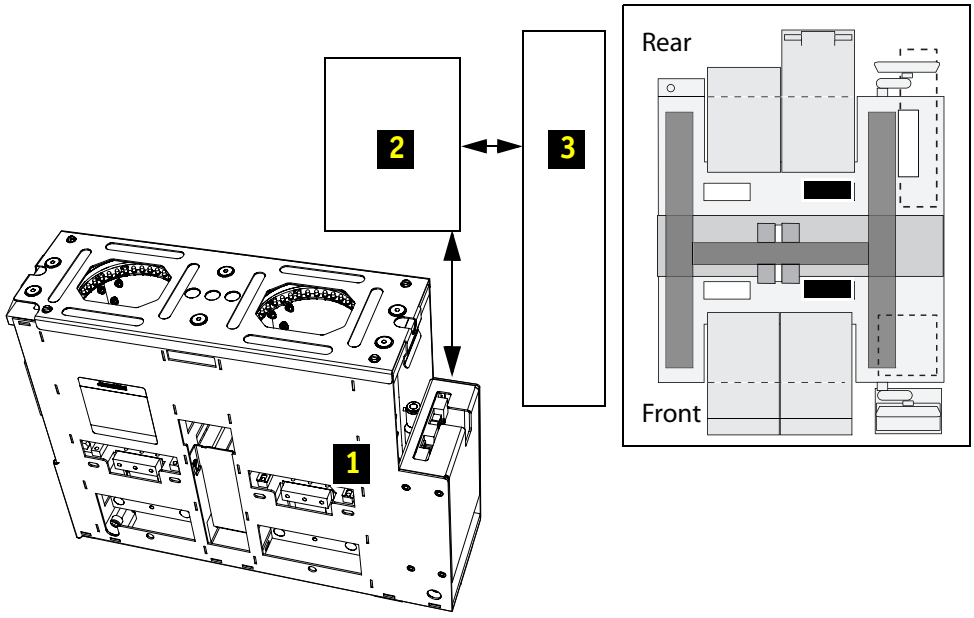

Figure 23 Component vision

Parts of the component vision system:

1. CV camera (large filed of view or small field of view)
2. Interconnection board base.
3. System controller.

This system (consisting of maximum two CV (component vision) cameras, firmware and software control) is used for the alignment of a wide range of components. The system obtains placement accuracy of the component on the board by determining how the component is positioned with respect to the placement head that picked it. This position is incorporated in the position where the placement head is lowered for placement. Furthermore it is used for checking (2D-inspection) components on leads, edges and bumps.

Component alignment is done by moving the placement head with the component above the lens of an upward-facing component alignment camera. Normally the machine is equipped with at least one large field of view (LFOV) camera. The machine has two camera positions where either a large field of view (LFOV) or small field of view (SFOV) camera can be mounted.

The CV camera can determine the position of the component with respect to a reference plate, which is part of the camera. The deviations will be used to compensate the placement position in the process.

NOTE: Components and background must fulfil certain contrast and light reflection conditions to create a good image on the camera. The component must be stable above the CV camera. The calculation is partly done during X-carriage movement. Shapes of components must be defined with the setup vision function and saved on the hard disk.

2.2.4.1 CV cameras

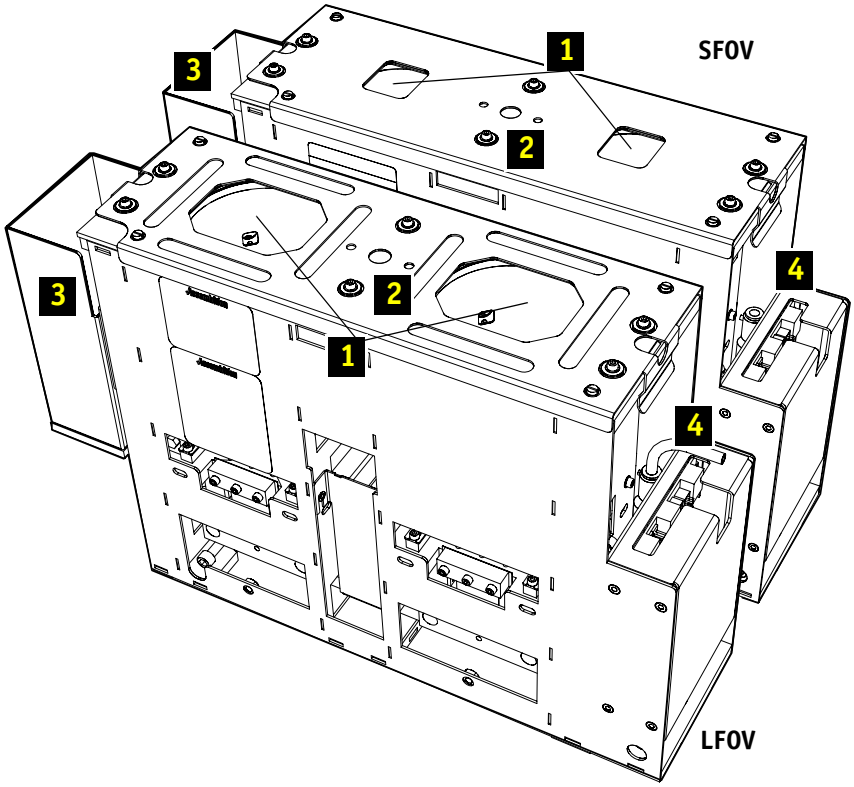

Figure 24 CV cameras, small field of view (SFOV) and large field of view (LFOV)

Parts of the CV camera:

1. Camera units
2. Reference plate
3. Removable dump bin (for components that fall onto the camera)
4. Fire Wire and power connection

The CV camera consists of two separate identical cameras.

When placement heads DV are used, the CV camera (LFOV) can take images of four components at the same time.

The controller sends a trigger signal to the camera to start an image intake. The image information is then sent to the controller via Fire Wire cables.

In the centre of the camera a dump bin will collect components that fall onto the camera. This will happen automatically.

The large field of view camera has four illumination sources:

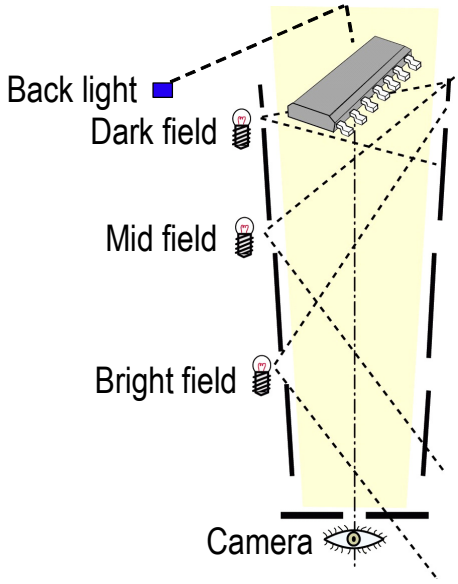

Figure 25 Schematic image of the four illumination sources

- **Bright field**, mostly used for leaded components. This beam of light creates a reflection on the leads and makes the leads visible for the camera
- **Mid field**, mostly used to optimize the reflection of the component in combination with dark or bright field illumination
- **Dark field**, mostly used for bumped components. This beam of light creates a shadow and makes the bumps visible for the camera
- **Back light**, mostly used for odd components where the outline is important for recognition.

The small field of view camera is in many ways similar to the large field of view camera. The main differences are:

- The small field of view camera is especially designed to detect components that require extreme high accuracy.
- The small field of view camera does not use back light.

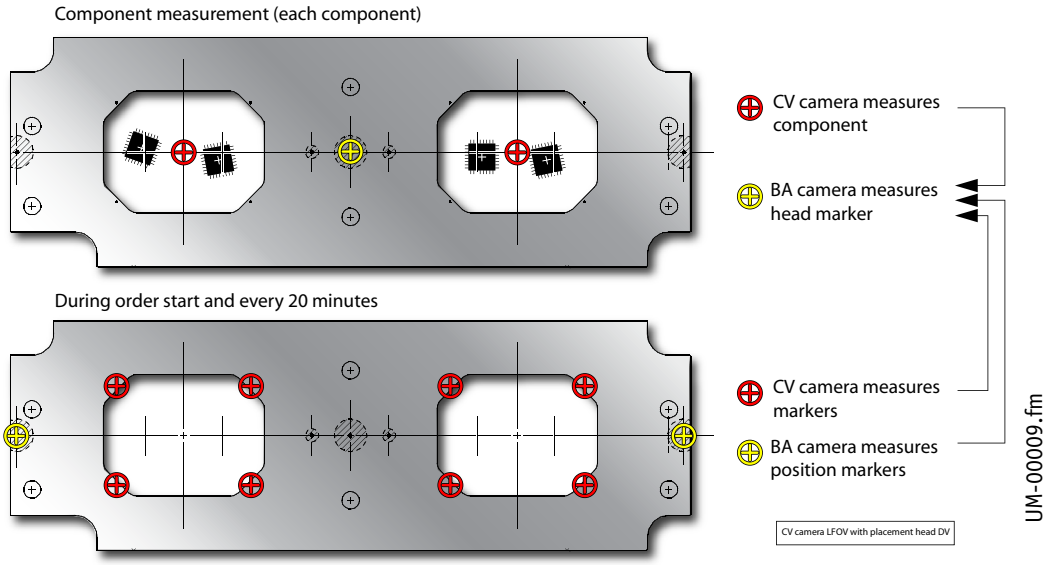

Figure 26 Component measurement principle

The principle of component measurement is as follows:

- Each time a component is measured, the CV camera takes an image of the component, while another camera, the Board Alignment (BA) camera, detects the position of the head marker on the reference place of the CV camera. This way the position of the component(s) with respect to the reference plate is known.
- Every 20 minutes (and after starting up a new order) the CV camera detects the position of a the eight CV markers on the reference place of the CV camera. At the same time the Board Alignment (BA) camera, detects the position of the two position markers on the reference place of the CV camera. This to correct for deviations due to temperature changes.

2.2.5 Board transport

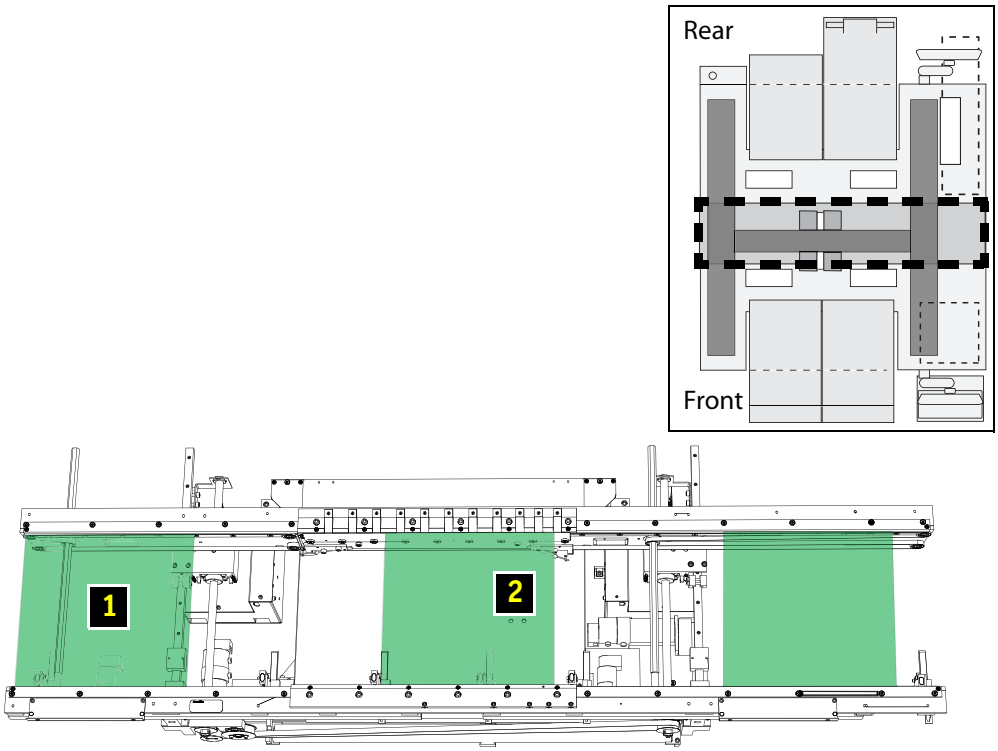

Figure 27 Board transport

The board transport module is an edge belt driven, front rail fixed transport conveyor. It is divided in two sections; "run-in" and "work-area".
The transport belt of each section can be driven separately.

The functions of each area are as follows:

1. Run-in section:
   - Accept boards from the previous machine or transport conveyor.
   - Buffer one board.
   - Identify the board with barcode (option).
   - Transport the board into the work-area.
2. Work-area section:
   - A board is positioned via a slow-down and stop sensor. The board is held in that position by clamping it during the placement of components.
   - Transport the board towards the following machine.

Characteristics of the board transport:

- Automatically adjustable width control (50 - 457 mm).
- The board support unit is provided with a grid area for manual pin adjustment.
- The interface between the run-in/run-out sections and the factory transport systems is done according to SMEMA Standard 1.1.
- It is possible to let boards pass through the work-area without any processing.
- Clamping needs 3 mm edge clearance.
- Clamping force is adjustable between 250N - 400N.

- Board index time is less than 3 sec.
- Board speed can be set between 50 mm/sec or 350 mm/sec.

A board which has entered the work-area is lifted from the belt by support strips and brought to height Z=0, where it is clamped.

During the placement process the board is supported by height adjustable magnetic support pins.

Clamping is done by a mechanism and serves two goals. The first is to hold the board in a fixed position and the second is to reduce the warpage of the board.

2.2.6 Board alignment

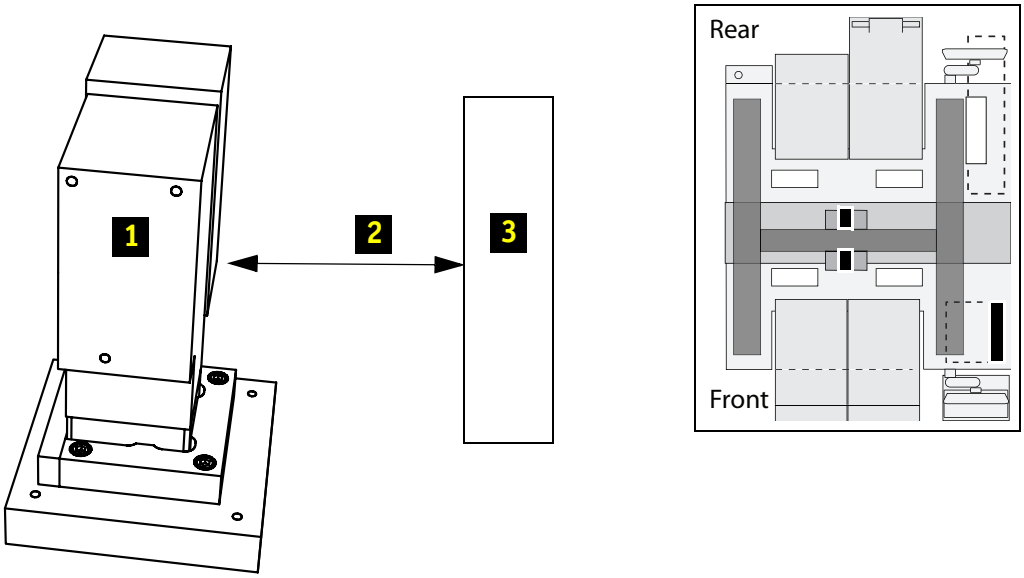

Figure 28 Board alignment

The board alignment system consists of:

1. Board alignment camera
2. Cabling
3. System controller

Board alignment is used to relate the board coordinate system to the machine coordinate system. This is done by measuring global and/or local fiducials located on the board. It can also be used for bad mark sensing and feeder pick-up point sensing and markers of the machine coordinate system located on the front of the Component Alignment camera.

Board alignment is done by projecting light on the board and measuring the intensity of the reflection with the help of an downward-facing board alignment camera. The dark surface of the board only reflects a small amount of light. Traces of white copper or solder (lead) reflect the light strongly. This contrast makes it possible to determine the position of orientation points on a board (hereafter mentioned as fiducial marks). These fiducial marks can occur in various forms and colours (as long as they contrast strongly with the environment).

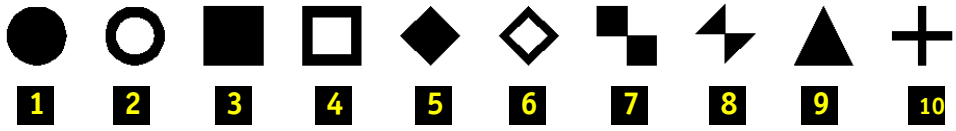

Figure 29 fiducials

Fiducial	Shape	Example file
1	Circle	CIR**CF
2	Donut	DON**CF
	Bowtie	BOW**CF
3	Square	SQR**CF
10	Plus	PLS**CF
	Cross	CRS**CF
9	Triangle	TRI**CF

Figure 30 Fiducials

At least two points are required on the board to determine its position. For a more accurate placement, asymmetrical board stretch must be taken into account, which requires at least three points, as shown in the figure below.

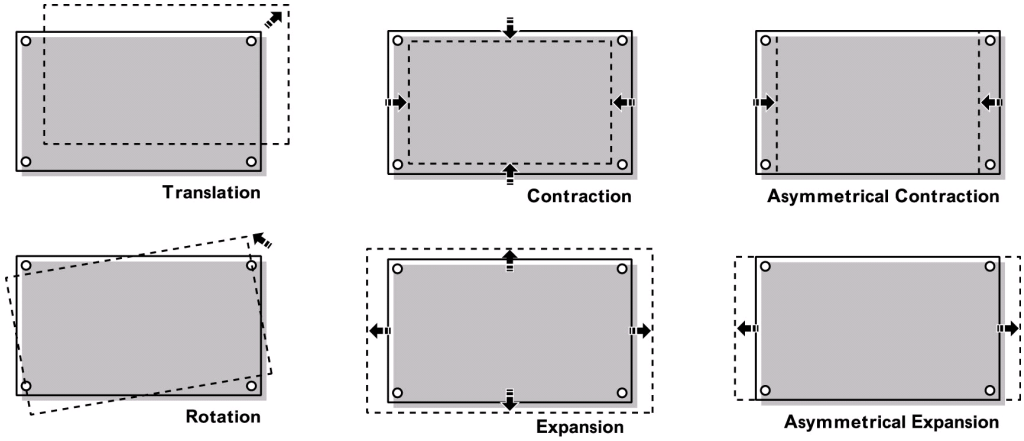

Figure 31 Number of necessary fiducials

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2.2.7 Machine control

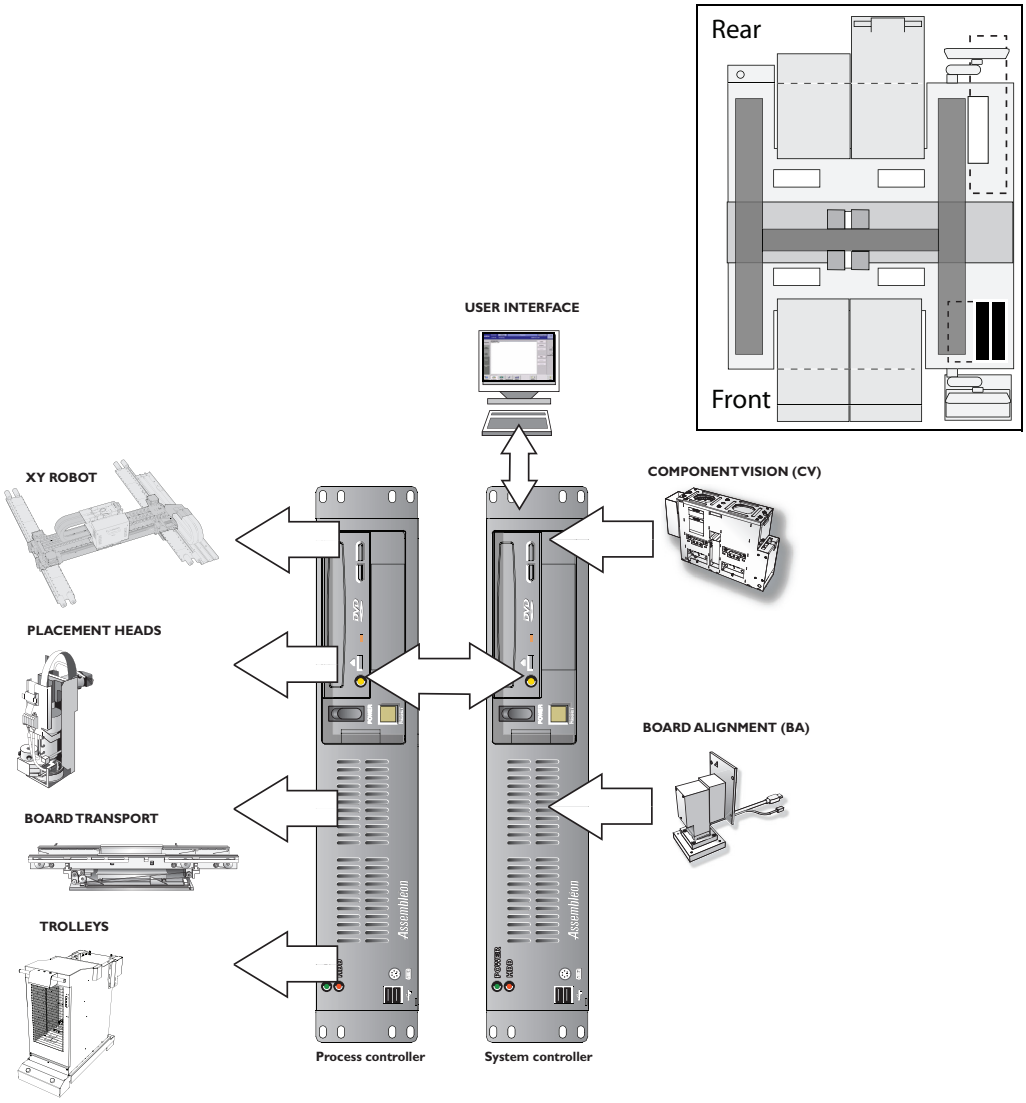

Figure 32 Control system architecture

2.2.7.1 System controller

The system controller coordinates the activities within the machine. It interacts with the process controller on a per board basis. The process controller executes the placement process. The system controller monitors the boards in the machine and initiates a change-over when required, this is based on orders entered by the operator or by process controller.

The system controller monitors the current machine set-up and checks it against the required set-up (as indicated in the data from PPS).

The main tasks of the system controller are:

- Providing a user interface.
- Interfacing with SVS Pro controller.
- Interfacing with production control system.
- Managing data sets:
  - Machine set-up.
  - Manufacturing performance data (basic and extended MIS).

- Maintenance data.
- Calibration data.
- Vision files.
- Placement programs.
- Accuracy verification.

- Managing orders.
- Identifying boards that enter the machine.
- Perform (automated) change-overs.
- Validate machine set-up.
- Control synchronisation between board transport and placement (once per board).
- Provide assistance in error recovery.
- Provide maintenance and service functions.
- Support system calibration procedures.
- Support of off-line machine documentation.

2.2.7.2 Process controller

The Process controller executes the placement program. It operates independently from the system controller during the placement on one board.

When the board is complete, interactions with the system controller take place. When an error situation occurs that cannot be handled autonomously, the process controller requests assistance from the system controller. The process controller also functions as gateway for some functions on the feeder controllers (e.g. related to component verification) and the transport controller.

The process controller is responsible for:

- Execution of the placement process on a per board basis.
- Providing automatic error recovery strategies.
- Coordinate the synchronisation between various controllers.
- Coordinate the synchronisation between the XY robot axes.
- Short term on-line calibration of the machine.
- Control hardware through subordinate controllers.

2.3 Component specifications

2.3.1 Component types

- 8/56 mm tape components (incl. 0402)
- Stick components
- Tray components
- BGA components
- Through hole components

2.3.2 Component restriction

■ Small components (R, C, Melf, SOT)	1 x 0.5 - □12 mm
■ ICs (SOIC, PLCC, QFP) pitch ≥ 0.4 mm	≤ □44 mm
■ Fine pitch ICs (FQFP) pitch ≥ 0.3 mm	≤ □44 mm
■ Grid arrays (BGA, MCM) pitch ≥ 0.65 mm	≤ □44 mm (no ceramic BGAs)
■ Bare Dies	□1.5 - □12 mm
■ Odd components pitch ≤ 0.5 mm	≤ □44 mm or ≤ 66 x 23 mm
■ Component height (mm)	min. 0.3 mm; max. 25 mm (16 with transmission illumination)
■ Component weight (g)	max. 15 gram (28 gram with gripper handling)
■ Coplanarity of (F)QFP components	According to EIAJ ED-7404A
■ µBGA pitch	≥ 0.65 mm ≤ □22 mm
■ Flip-chips'	max size 13x13 mm, bump diameters 75-175 µmboth perimeter and internalw.r.t. flux applicator

- Through hole components require a special placement algorithm compared to components. The leads of a through hole component might bend if they are not properly aligned and therefore hit the surface of the board instead of going through the holes in the board. It is important that the machine can detect that the leads hit the surface of the board. If this is the case placement can be interrupted and retried (dump component, pick a new one, align and place).

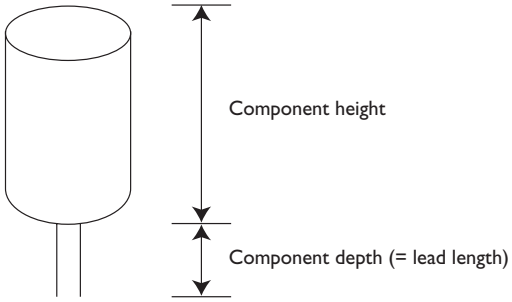

Figure 33 Through hole component

The scenario for placing through hole components is as follows:

- Let the head travel full speed (movement class dependant) to a height of 1.7 mm (defined in PRO.CFG) above the board surface measured from the bottom of the leads (lead length is taken into account).
- Switch to collision speed.

- Interrupt placement if a collision is detected during the first n mm (lead length) with a new process error (e.g. Unexpected collision detected during placement).
- If no collision is detected continue placement with collision speed and end placement as usual.

2.3.3 Component packaging

■ Tape	Tape sizes of 8-56 mm wide can be used.
■	Reel diameters up to 330 mm (13”) are full supported; 380 mm (15”) on Feeder Bank only.

Two important standardisation documents are applicable:

1. Packaging of leadless components on continuous tapes (IEC publications 286-3, second edition, 1991-02).
2. Taping of components for automatic placement (EIA Standard: EIA-481 rev. A, 1986).

■ Stick packages	According to feeder supplier.
■ Tray packages	According to IEC publications 286-5 (matrix trays). Tray sizes up to 347 x 274 mm are supported.
■ Mini-trays	Matrix trays. Tray sizes of 50 x 50 mm and 100 x 100 mm are supported.

2.3.4 Component feeding

■ Tape feeders	PA2654/xx
■ Surf-tape	via Auxiliary Die Eject (Flip) Feeder
■ Stick feeders	PA2659/xx
■ Mini-tray	via auxiliary waffle pack feeder

NOTE: Feeder trolley and feeder bank do not support any form of gang picking (feeder pitch differs from placement head pitch)

2.3.5 Empty feeder exchange

■ Tape feeders	Feeder can be replenished or refilled during run-time (tape splicing possible)
■ Stick feeders	Feeder can be refilled during run-time.
■ Tray trolley	Magazine can be refilled during run-time.
■ Tray pallet	Not possible during run-time.
■ Tape waste	No automatic cut off of tape remainders (manual action). Tape remainders will be disposed in a bin. Bin can be emptied during run-time.
■ Tray carriers	Tray carrier magazine can be refilled during run-time.
■ Mini-trays	Waffle pack feeder can be refilled during run-time.

2.3.6 Feeding area

All feeder systems can be placed on the front or rear side of the machine. A side is divided in 2 sections. Per section, tape, stick or tray feeders can be selected freely.

- Maximum feeder space 960 mm (2 x 480 mm)
- Maximum pick area 810 x 350 mm (X x Y)
- Maximum number of component feeders
  50 tapes 8 mm or 2 tray trolleys with 50 carriers each per side.

2.3.7 Component fixing

- The machine will not apply any glue or solder paste itself but will support the necessary placement processes for glue or solder paste applications.
- Flip-chip types with PA 2679/00 (Fluxer). Flux depth is manually adjustable. The applicator has programmable dip time, dip force and dwell time settings.

2.3.8 Placement forces

The required placement forces are specified in the PTDB.

2.3.9 Component dumping

Rejected components will be returned to one of the reject possibilities. A basket (mounted on the CV camera) for low cost components which may be thrown away OR the dump reuse unit (PA1290/00) for expensive components which might be reused after repair.

2.4 Board specifications

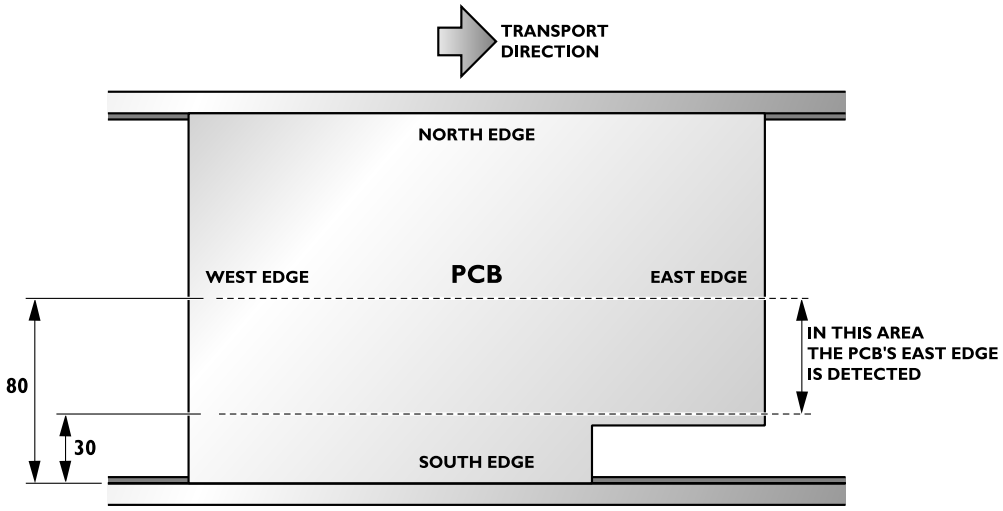

Figure 34 Board (odd shape) positioning

- Length : 50 - 515 mm (tolerance ± 0.5 mm)
- Width : 50 - 457 mm (tolerance ± 0.5 mm)

NOTE: Min. board-length limited to 80 mm if thickness ≤ 0.6 mm.
Max. board width limited to 350 mm if Flux Applicator is mounted.

ITEM	REQUIREMENT
Thickness	0.3 mm to 6.0 mm
Tolerance thickness	± 10% or 0.1 mm whichever is largest

ITEM	REQUIREMENT
Min./Max. dimensions	50 to 508 mm parallel with transport direction. 50 to 460 mm perpendicular to transport direction
Tolerances length/width	± 0.5 mm
Flatness	Max. topside bow = 0.6% of diagonal, but max. value = 1 mm. Max. bottom side bow = 5 mm
Mass	Max. 3 kg
Clearance	3 mm free of components at two sides parallel with transport direction
Shape of board	When there is no east edge of a board (Figure 34) within the area of 30-80 mm measured from the south edge special measures are necessary. Odd shapes (like circles) must be handled via carriers in which case special care must be taken
Pre-mounted components	Top side: max. height = 25 mm. Bottom side max. height = 33 mm. When the edge clearance is over 7 mm then bottom side max. height = 45 mm
Materials	Phenolic/paper (FR-2), glass epoxy (FR-4)
Fiducial size	0.8 to 3.0 mm
Fiducials	All regular types of global/local and/or local fiducials within a board (fitting within a circle of 3.0mm).
Tolerances	Location of fiducial to edges at south east corner of board, ± 0.2 mm

Figure 35 bard specifications

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CHAPTER 3 Safety

3.1 General

For the correct and safe use of this machine, it is essential that all personnel should follow the safety procedures specified in this manual.

All manuals have danger, warning and cautionary statements where applicable.

Danger, warning and cautionary statements and / or symbols are present on the machine where applicable.

3.2 Personnel qualification

Operation, adjustment, maintenance and repair of this machine shall be carried out by **qualified and trained** personnel only.

The following training levels are defined:

- Operator level.
- User or supervisor level.
- Maintenance or service level.

NOTE: For each level an official Assembléon training is available.

3.3 Basic safety rules

- Do not use the machine in an environment where flammable gasses are present or where it is extremely dirty.
- When any personal protection equipment (PPE) is mentioned, it should be used in accordance with the manufacturers instructions.
- Do not defeat or bridge safety devices, connectors etc.
- Use only Assembléon recommended spares and tools.
- Keep fingers and other body parts outside the machine.

3.4 Safety compliance

The safety of this machine is based on industry-specific criteria (international codes, regulations, and standards).

Since this machine is designed for operation in a flow line, full mechanical safety in accordance with these criteria is only guaranteed when openings of the run-in and run-out sections are covered by the preceding and succeeding equipment in the flow line.

This machine should not be operated as a stand-alone machine.

3.5 Danger, warning and caution

■ Danger

Danger indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

A danger statement is displayed in this manner:

HAZARD IDENTIFICATION
Hazard consequence.
Hazard avoidance.

■ Warning

Warning indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

A warning statement is displayed in this manner:

HAZARD IDENTIFICATION
Hazard consequence.
Hazard avoidance.

■ Caution

Caution indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It may also be used to alert against unsafe practices.

A caution statement is displayed in this manner:

HAZARD IDENTIFICATION
Hazard consequence.
Hazard avoidance.

3.6 Safety stickers

Pictogram	Category	Meaning
1 	Warning	**DANGER OF CLAMPING FINGERS** Serious injury to fingers. Keep hands away from moving parts.
2 	Warning	**DANGER OF STRONG MAGNETIC FIELD** Pacemaker and metal prosthetic users are at risk of serious injury or death. Stay away from the magnets.
3 	Warning	**DANGER, HIGH VOLTAGE** Contact may cause electric shock or burn. Turn off & lock out system before servicing.

Figure 36 Safety stickers

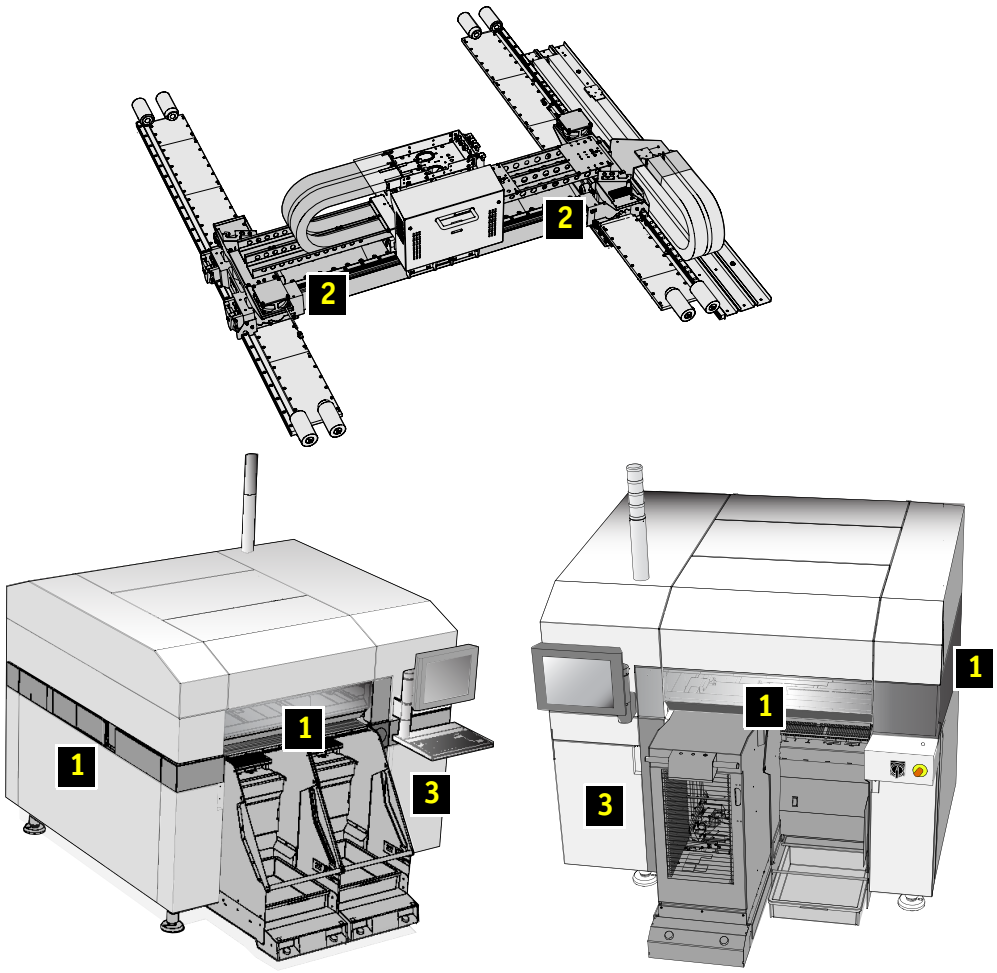

Figure 37 Location of safety stickers

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3.7 Safety devices

	Safety device	Hazard protected	Detection method	Machine condition after safety device is activated
1	Emergency stop button front and rear	Hazardous moving parts.	Safety circuit interruption by pushing the emergency stop button.	All moving parts will be stopped and power to servo systems is turned off.
2	Safety interlock.	Hazardous moving parts.	Safety circuit interruption by opening hood rear.	
3			Safety circuit interruption by opening hood front.	
4			Safety circuit interruption by lowering any trolley.	
5			Safety circuit interruption by removing any trolley lift cover.	
6	"Start on" button. PA 2410/00 only.	Uncontrolled power up	Preventing uncontrolled power up of machine after power failure.	Power to the machine is turned on.
7	Electrical disconnect.	Hazardous voltage.	Mains power supply to the machine interruption by turning the electrical main switch to 'off'.	All power to the machine is turned off.
8	Air disconnect.	Hazardous air pressure.	Main air supply to the machine interruption by turning the main air switch to 'off'.	All air pressure to the machine is turned off, and present air pressure is released safely.
9	Enabling switch front and rear	Hazardous moving parts	Device for running the machine with the front or rear hood opened, when troubleshooting, teaching or servicing. See 3.7.1.Enabling switch front/rear, usage	The XY robot runs at 12.5 % of its normal speed.

Figure 38 Safety devices

Locations of safety devices are depicted in Figure 39 and Figure 40.

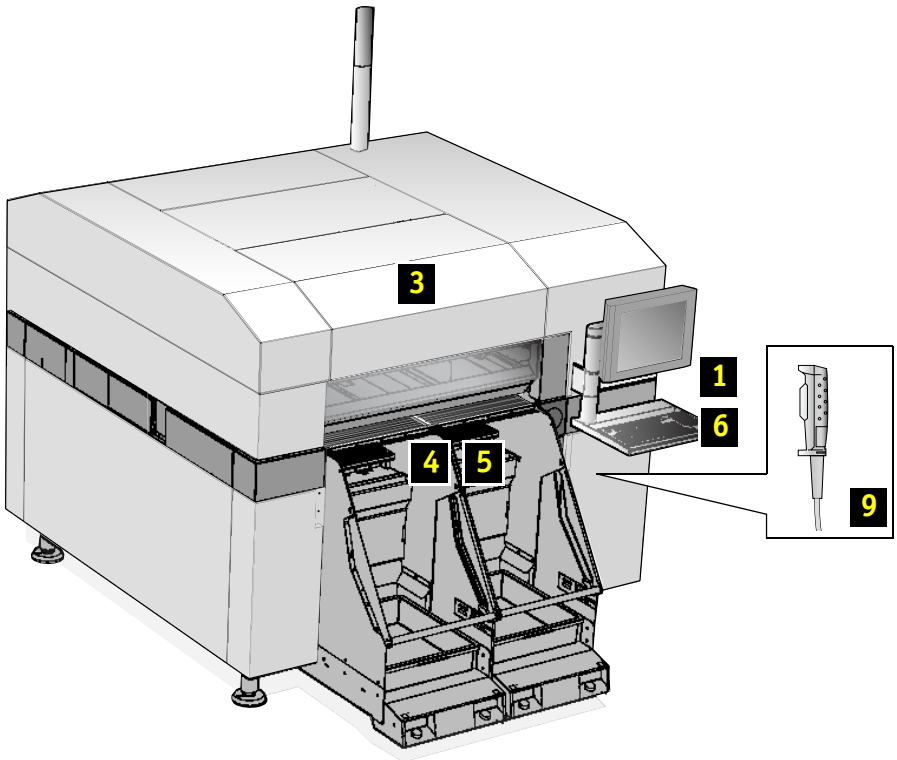

Figure 39 Location of safety devices, front

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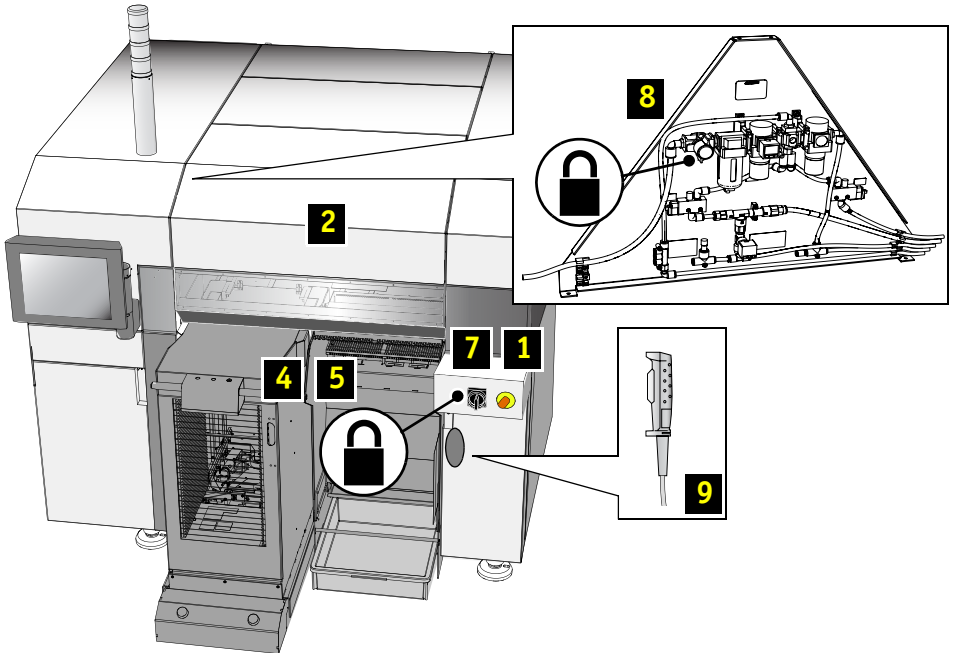


Figure 40 Location of safety devices, rear

Lock the electrical main switch (7) and the air main switch (8) by a padlock to avoid unauthorized use.

3.7.1 Enabling switch front/rear, usage

CAUTION

DANGER OF MOVING PARTS
Serious injury to fingers and body parts.
Keep fingers and body parts outside the machine.

Use the enabling switch (1) only as a hold-to-run device to suspend the safety function of the hood (2). Keep fingers and other body parts outside the machine when using the enabling switch (1).

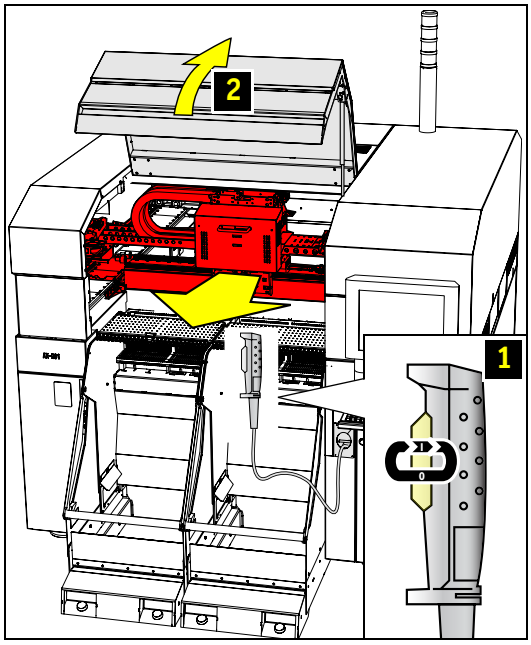
For teaching pick positions or for trouble shooting the machine can be operated with the hood (2) in opened position by using the enabling switch (1).

XY robot operation with open hood (2) is only possible when the enabling switch (1) is held in the middle position.

The XY robot (3) will run at 12.5 % of its normal speed.

Releasing the enabling switch (1) or squeezing the switch blocks further XY robot operation.

Each hood (front/rear) has its own enabling switch (front/rear).



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3.8 Noise levels

Location	Noise level
Sound pressure at operator's position	≤ 72 dB(A)
Average environmental noise level during measurement	≤ 58 dB(A)

Figure 41 Noise levels

3.9 Emergency contact

In case assistance is needed during an emergency situation, contact the regional Assembléon organization.

Region	Number
Asia	+65-62-61-4611
America's	+1-800-474-4547
Europe	+31-20-5040679

Figure 42 Numbers

3.10 Liability

Assembléon will not be liable for any costs, damages or personal injuries if the machine is not used according to the safety rules given in this manual.
Instructions written in English are original instructions.
Instructions written in other languages are a translation of the original.

3.11 Recommended tools for working safely

	Description	Picture	Application
1	Stepstool		Useful for smaller persons: reaching inside the machine or closing hoods.
2	Pallet truck		Lifting and moving of heavy modules.
3	Gloves		Skin protection during lubrication.

Figure 43 Recommended tools for working safely

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CHAPTER 4 Prepare production

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4.1 Trolley, placing and removing

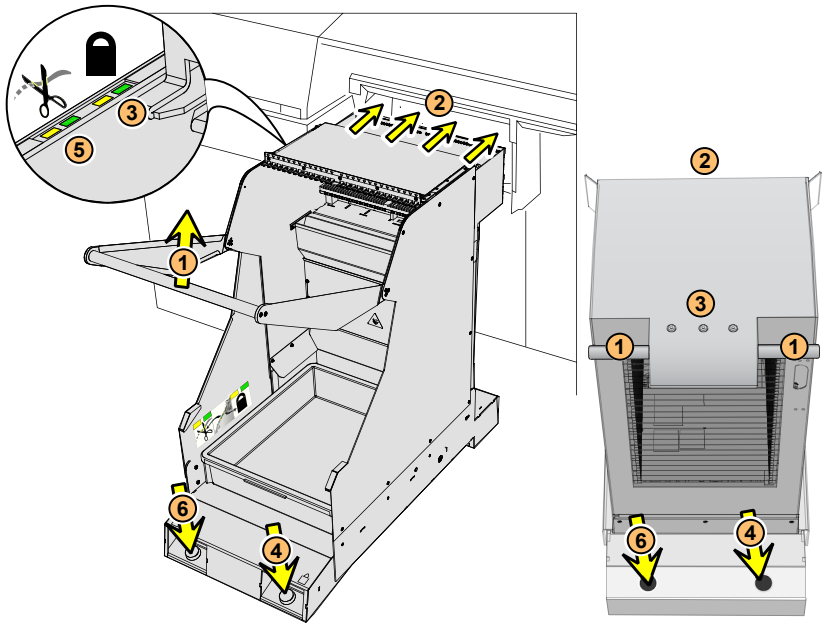

Figure 44 Placing and removing a trolley

NOTE: A trolley can only be placed and removed with the main switch turned on, followed by pushing the start button.

- Power up the machine, see 4.2.Power up the machine
- Remove the safety cover from the machine before placing the trolley.
- Take the handle (1) and roll the trolley to the machine.
- Position the trolley in the required trolley slot (2). If positioned correctly the yellow LED (3) is on.
- Push the button (4) until the feeder trolley is fully lifted. When locked, the green LED (3) is on.
- Remove the trolley by pushing the button (6).

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4.2 Power up the machine

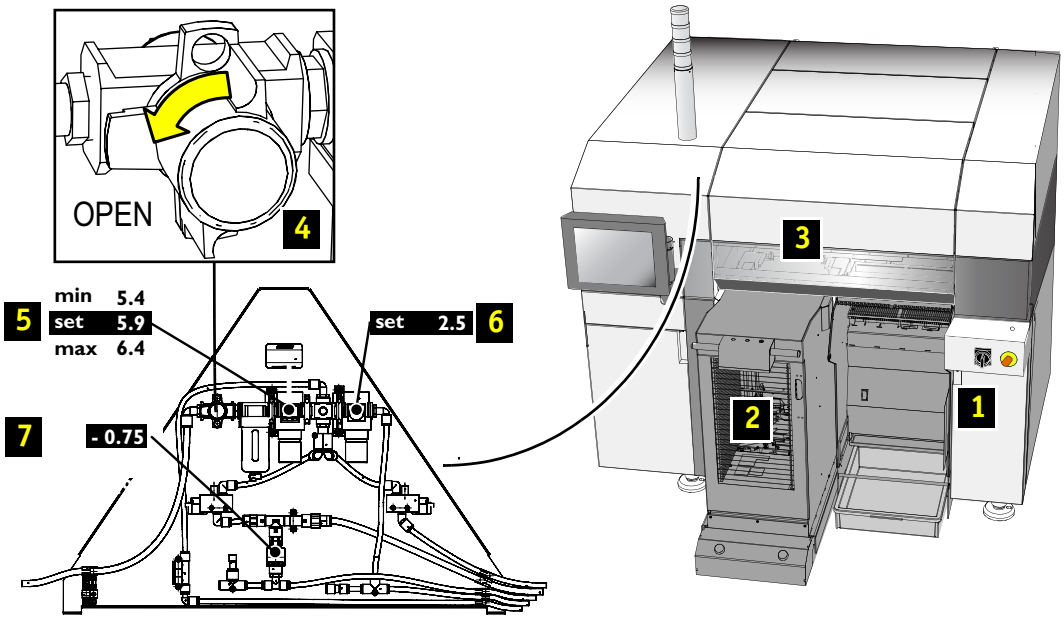


Figure 45 Power and air supply

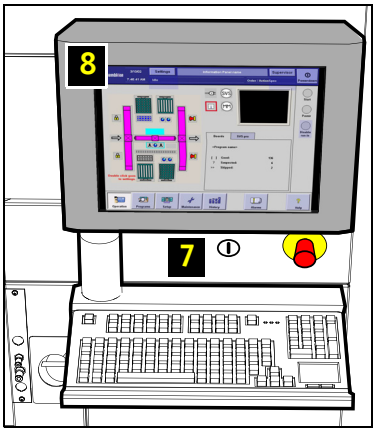
■ Go to the back of the machine.

- Remove the padlock and switch on the main switch (1).

Initial start up only:

- Remove the trolley (2), see 4.1.Trolley, placing and removing, and open the rear cover (3).
- Set the air valve (4) inside the machine to the OPEN position.
- Check if compressed air (5), blower air (6) and vacuum (7) gauges show the correct values.
- Close the rear cover (1), and place trolley, see 4.1.Trolley, placing and removing.

■ Go to the front of the machine.



- Push the start button (7) (PA 2410/00 only).
- Wait until the main screen (8) appears.

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4.3 Machine cleaning

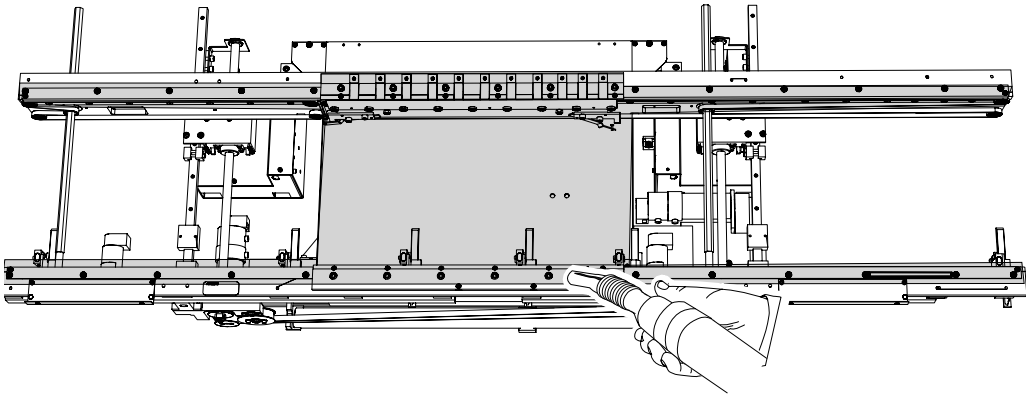

Figure 46 Machine cleaning

Use the following materials to clean the machine:

- Vacuum cleaner
- Brush

NOTE: Never use compressed air for cleaning. (Waste would be blown into fine mechanical parts, causing damage and malfunctioning of the machine.) Use, when necessary, the steps tool to prevent an unsafe work load during machine cleaning.

To clean the machine:

1. Remove the trolleys, see 4.1.Trolley, placing and removing
2. Open the front and rear cover.
3. Remove with a vacuum cleaner:
   - Wasted components in transport area.
   - Wasted components on trolley areas.
   - Components in the dump bin.

4.3.1 Feeder trolley, cleaning

- Remove with a vacuum cleaner the wasted components on feeder positions.
- Feeder trolley only:

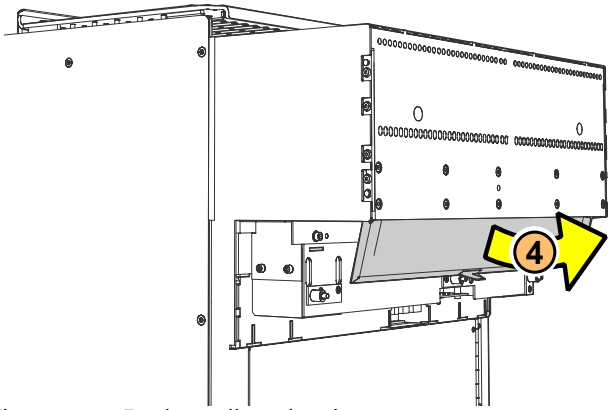

Figure 47 Feeder trolley, cleaning

Open the lid (4) and remove components from the feeder trolley.

4.4 Log on

The machine has three user levels: Operating, Supervisor and M&S engineer.

By default the machine starts at operating level, without a password.

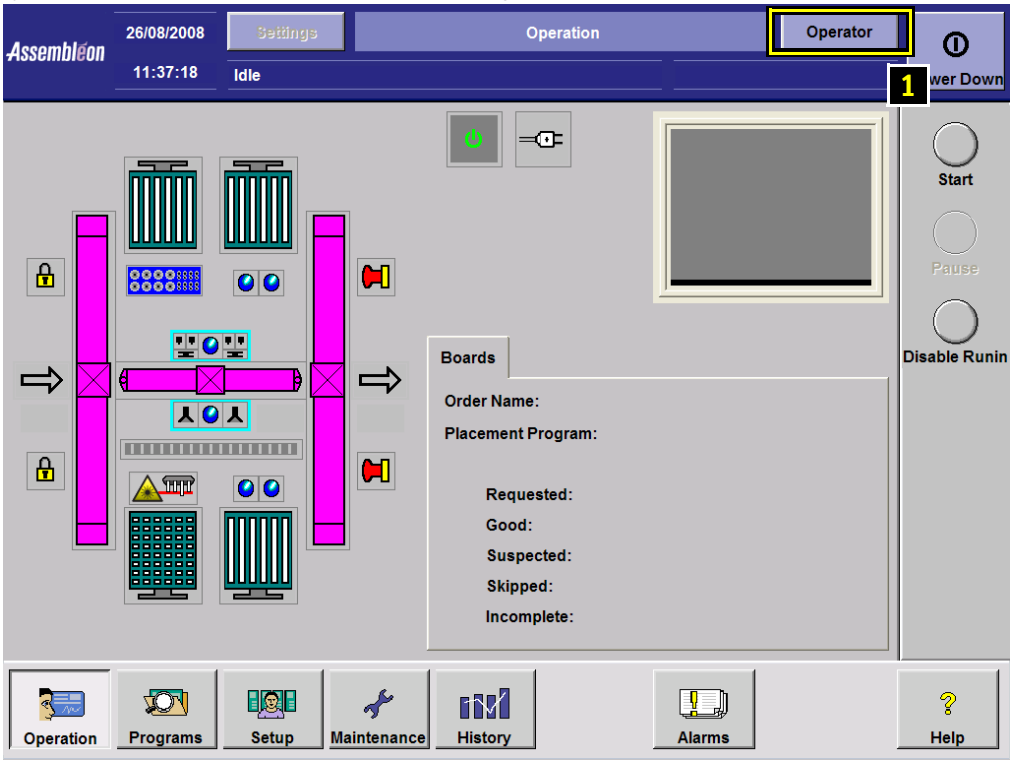

Figure 48 Default log on screen on operating level

To change the user level:

- Click on the box that displays the current user level (1). Figure 49 will appear now.

Figure 49 Change user level

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4.5 Module configuration, setting or adapting

Changing the configuration is performed in two situations:

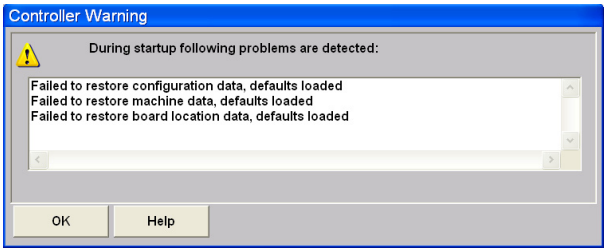
- After installation or upgrading the application software the machine will have no module configuration, It must be set again, see 4.5.1 Module configuration, setting
- When adding or changing a camera, trolley or fluxer, the update of the setup is not automated, and must be adapted, see 4.5.2 Module configuration, adapting

4.5.1 Module configuration, setting

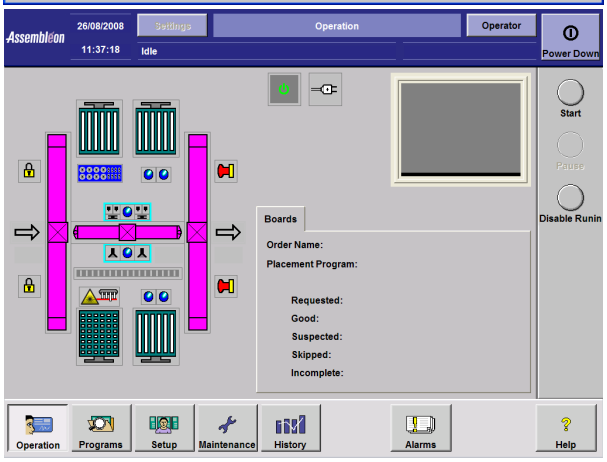
1. Start up the machine

The following screen will appear.

- Click on 'OK' to remove the warning.



The following screen will appear.

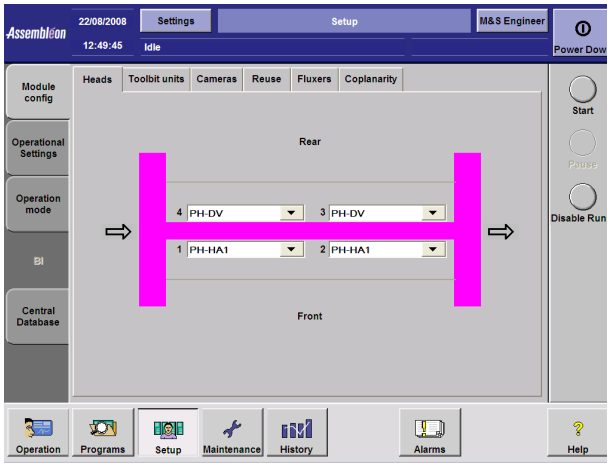


2. Select module configuration

- Log in as M&S engineer.
- Select 'Setup'
- Select 'Module config'

The following screen will appear.

All changes will be effective immediately.



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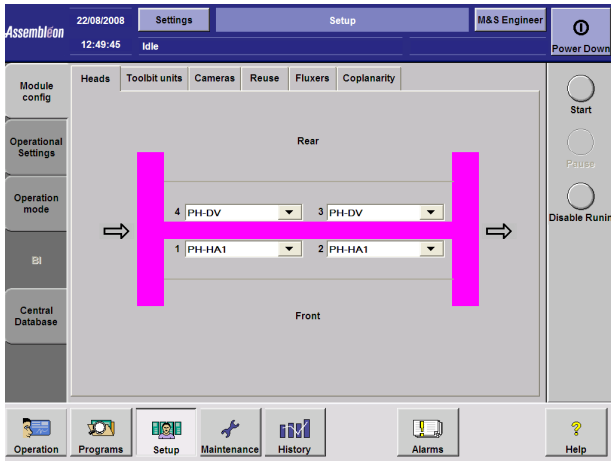
3. Configure heads

- Select the 'Heads' tab.

The following screen will appear.

- Select for each placement head slot the applicable placement head.

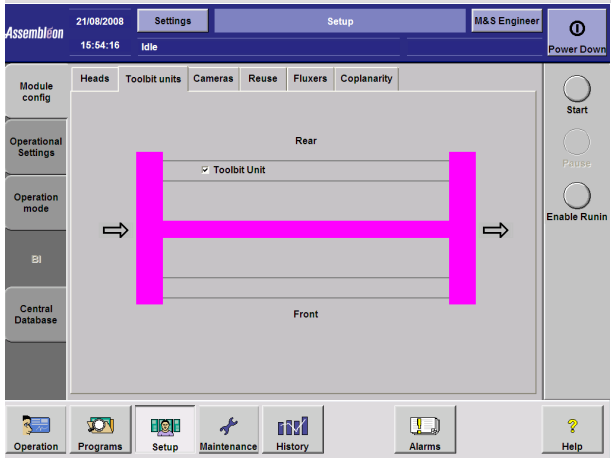


4. Configure toolbit units

- Select the 'Toolbit Units' tab.

The following screen will appear.

- Select the rear toolbit unit.

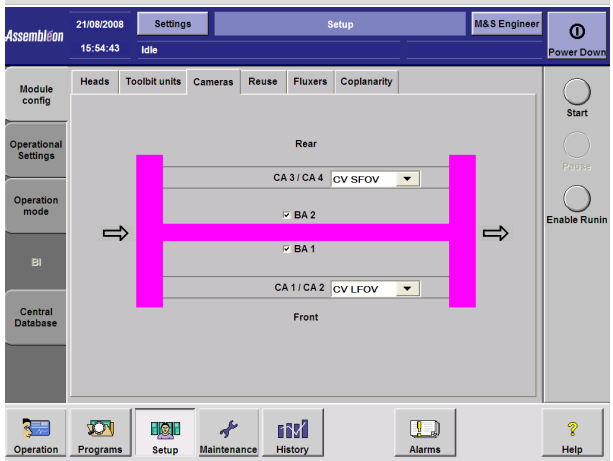


5. Configure cameras

- Select the 'Cameras' tab.

The following screen will appear.

- Select 'Front', 'BA 1' camera.
- Select the applicable other camera's for each camera position.

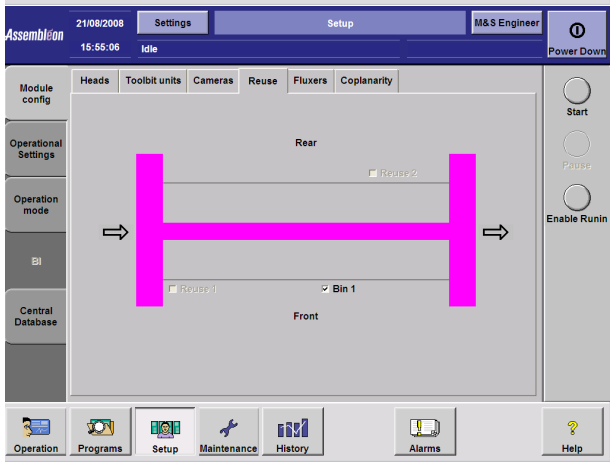


6. Configure reuse station

- Select the 'Reuse' tab.

The following screen will appear.

- Select 'Bin 1' at the front.
- Select if applicable 'Reuse 1' at the front.



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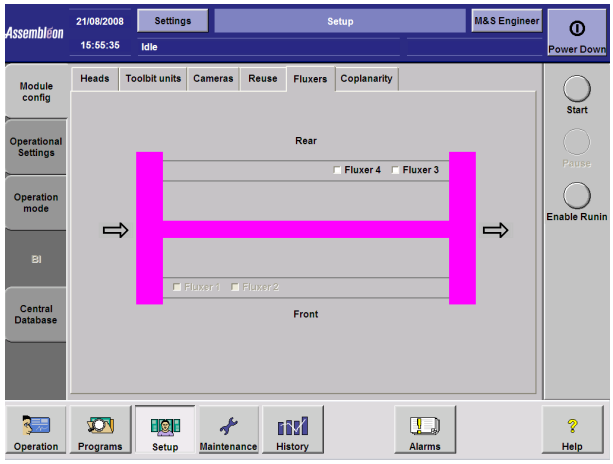
7. Configure fluxer

- Select the 'Fluxers' tab.

The following screen will appear.

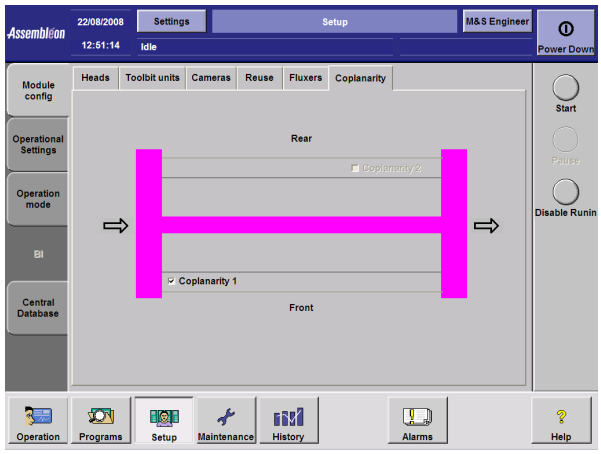
- Select the applicable fluxers.



8. Configure coplanarity

- Select the 'coplanarity' tab.

The following screen will appear.

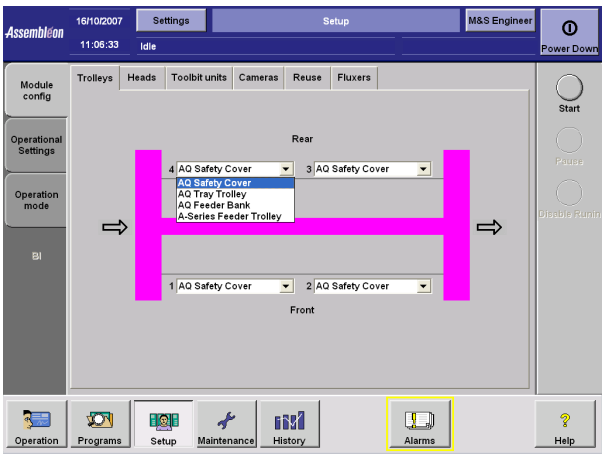


4.5.2 Module configuration, adapting

1. Adapt the module configuration

- Log in as M&S engineer.
- Stop production.
- Abort the running order.
- Select 'Setup'.
- Select 'Module Config'.
- Select the applicable tab (see 4.5.1 for all possible screens).
- Make the change.

The change will be effective immediately.



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4.6 Placement program, loading

The machine executes orders as listed in the order schedule. Each order uses a placement program that describes the actions that the machine must take to produce a board. If the placement program is already loaded on the system controller a new order can be created right away. However, if the placement program is not on the machine, it must be loaded first.

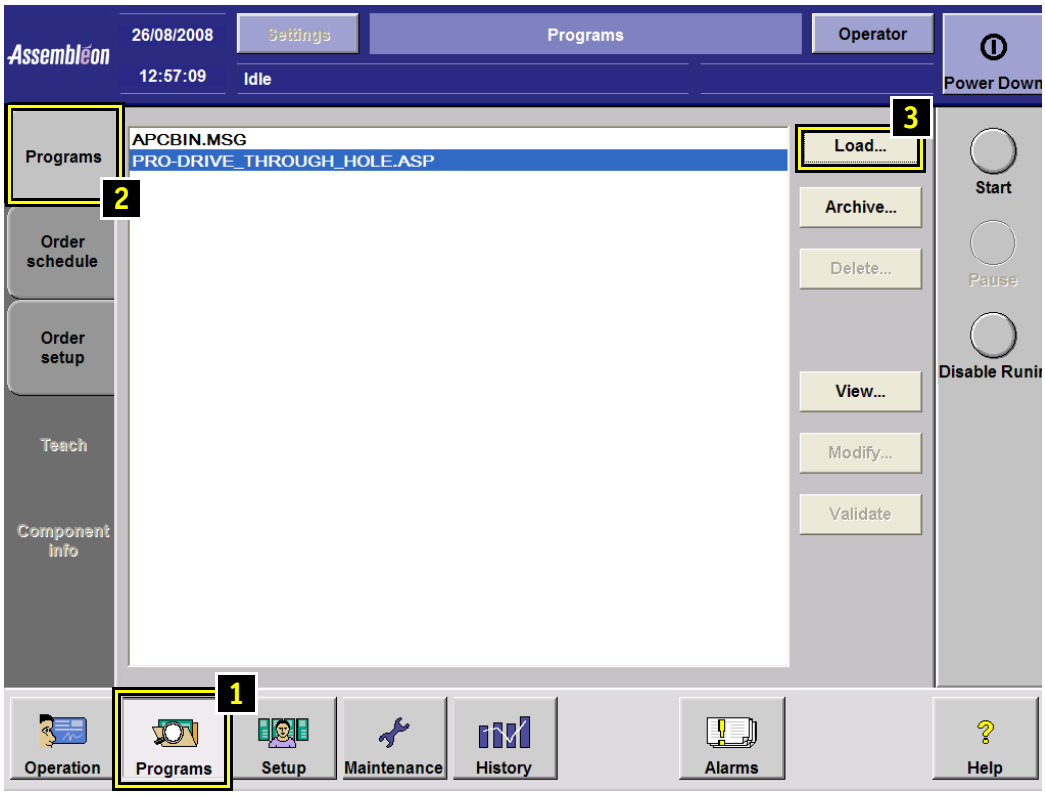

Figure 50 Loading a placement program

To load a placement program:

1. Select “Programs” from the main menu.
2. Select “Programs” from the sub-menu.
3. Click on “Load”, to open the “load program screen”.

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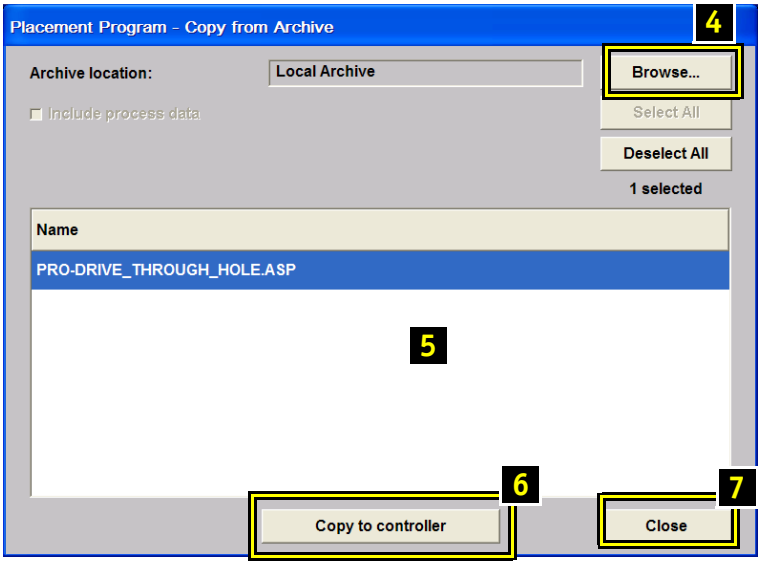

Figure 51

4. Click on “Browse” to search for the placement program on other places.
5. Select the applicable placement program by clicking on it.
6. Click on “Copy” to copy the placement program to the controller.
7. Click on “OK” to close the “load program screen”.

4.7 Order, schedule

Once the placement program is loaded, an order can be created in which the placement program is executed.

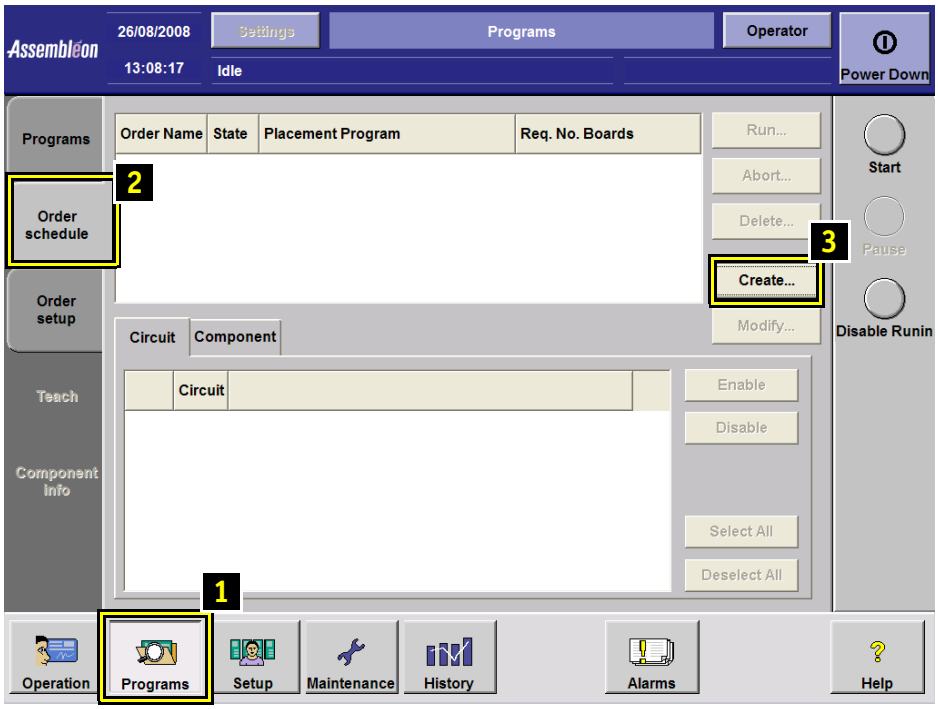

Figure 52 Creating an order

To create an order:

1. Select “Programs” from the main menu (if not already selected).
2. Select “Order schedule” from the sub-menu.
3. Click on “Create” to create an order in the schedule.

The following screen appears:

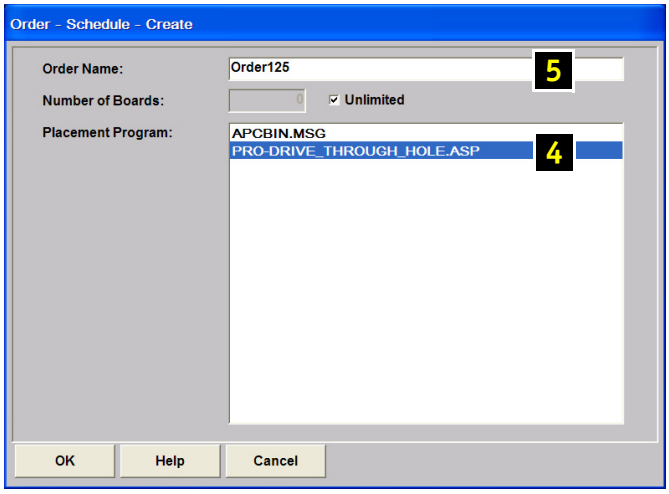

Figure 53 Creating an order

4. Select the applicable placement program from the list.
5. Enter an order name and the number of boards to be produced.

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The order will now be displayed in the order schedule.

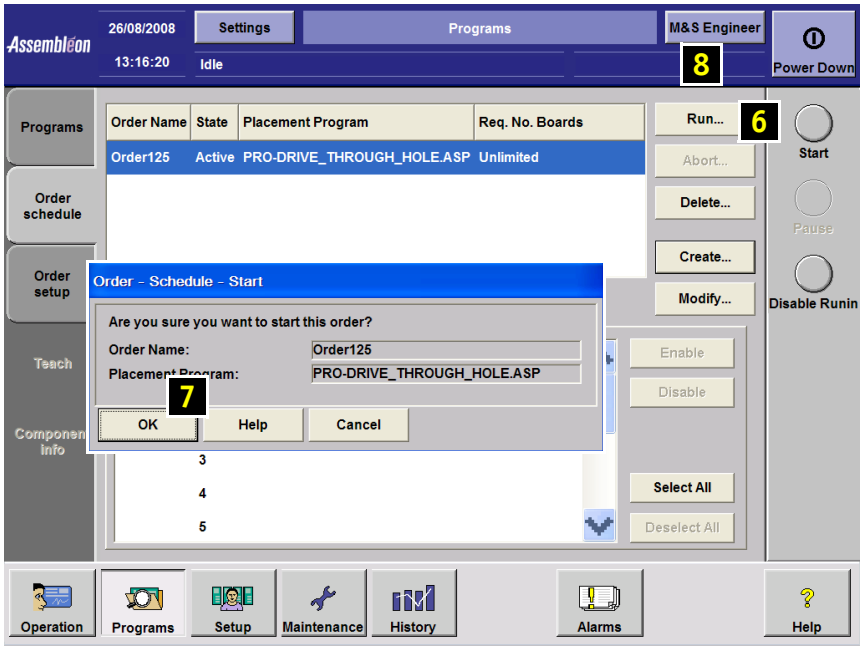

Figure 54

- Run the order (6).
- Confirm with 'OK' (7).

The name of the placement program will now appear in the header (8).

4.7.1 Circuit placement, disabling or enabling

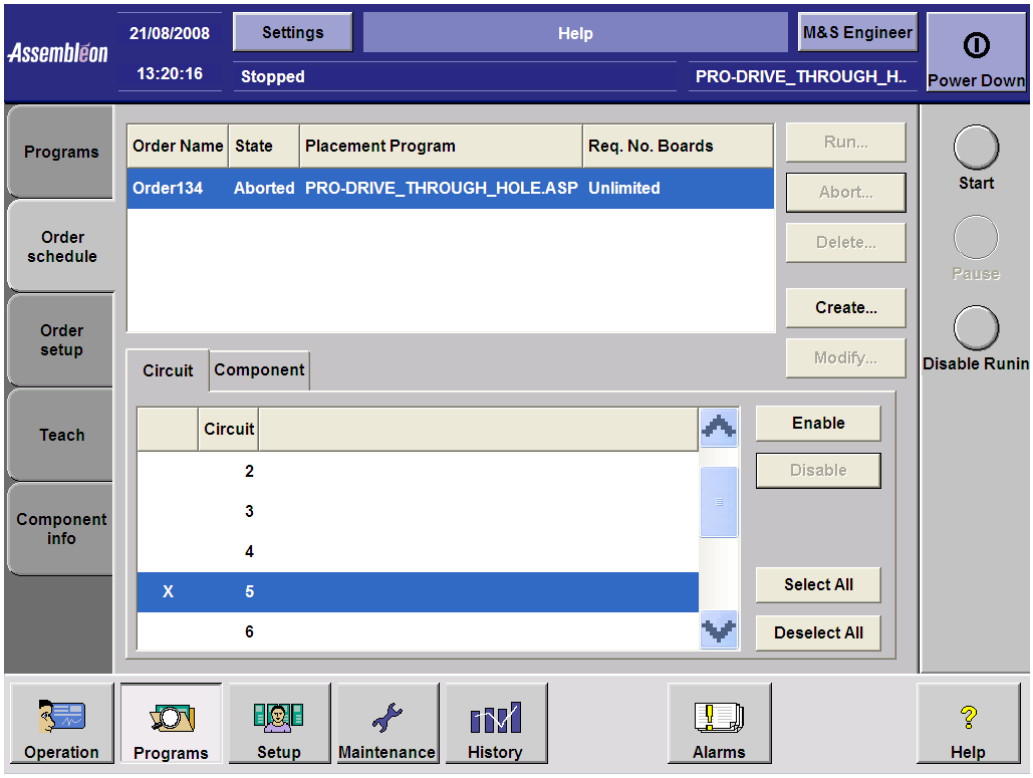

Figure 55

- CIRCUIT: The list with circuit information on the selected order:
  1st column, an X in this column is a disabled circuit.
  Circuit, the number of the circuit.
  Selecting a row header will sort the table.
- ENABLE: To enable the selected circuit.
- DISABLE: To disable the selected circuit.
- SELECT ALL: To select all circuits on the board.
- DESELECT ALL: To de-select all circuits on the board.

4.7.2 Component placement, disabling or enabling

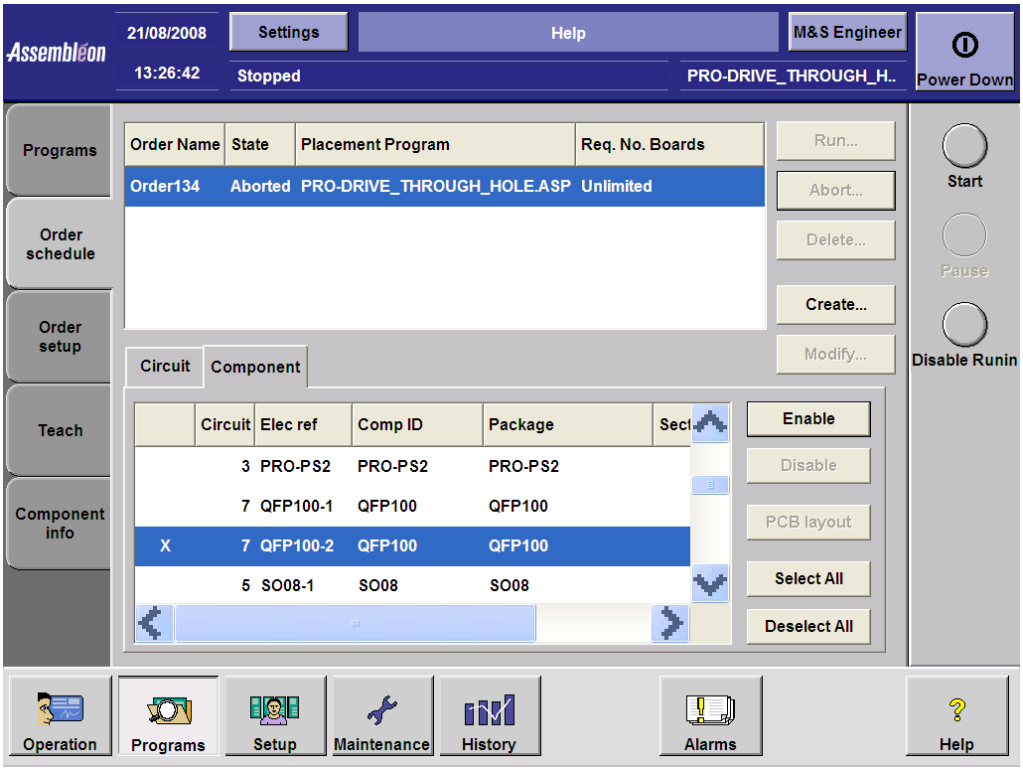

Figure 56

- COMPONENT: The list with component information on the selected order:
  - 1st column, an X in this column is a disabled component.
  - Circuit, the number of the circuit where the component is located.
  - Elec ref, the electrical reference of the component.
  - Comp ID, the ID of the component.
  - Package, the package of the component.
  - Section, the section where the component is picked.
  - Number, the number of the feeder or tray where the component is picked.
  - Channel, the channel of the feeder or tray where the component is picked. - Selecting a row header will sort the list.
- ENABLE: To enable the selected component.
- DISABLE: To disable the selected component.
- PCB LAYOUT: To select a component with help of a graphical presentation of the PCB.
- SELECT ALL: To select all components on the board.
- DESELECT ALL: To de-select all components on the board.

4.8 Machine setup

Before an order can be started, the order setup must be checked. In the order setup feeders, board transport and toolbits are checked.

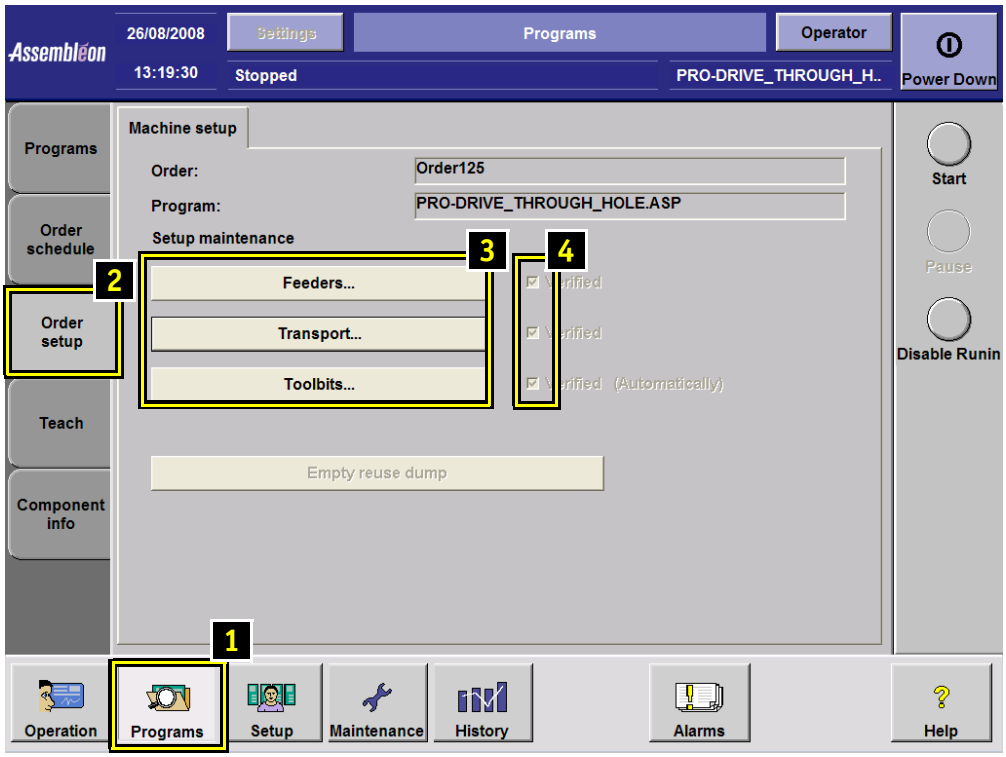

Figure 57 Machine setup

To open the “Order setup” screen:

- Select “Programs” (1).
- Select “Order setup” (2).

All set-up requirements for feeders, transport and toolbits must have been done before production can be started. The user must tick the 'Verified' check boxes (4) for each of these items when they have been checked and found correct.

- Select:
  - Feeders, see 4.9.1.Feeders, setup
  - Transport, see 4.10.Transport, setup
  - Toolbits, see 4.11.Toolbits setup

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4.9 Trolleys

Trolley handling, see 4.1.Trolley, placing and removing

4.9.1 Feeders, setup

The user can inspect, enter or change the feeder setup of the machine. The first pick-up location of a tray can be defined and feeders can be disabled. The current feeder section configuration of the machine is shown in Figure 58..

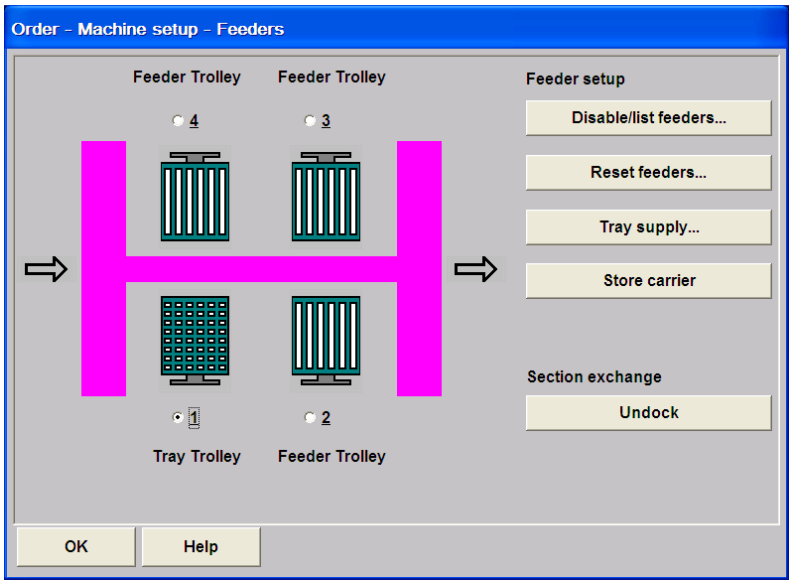

Figure 58

- Select a trolley for editing.
- DISABLE/LIST FEEDERS: 4.9.1.1.Disable / list feeders:
  Opens the window to inspect the feeder setup and disable or enable feeders of the selected trolley.
- RESET FEEDERS: 4.9.1.2.Reset feeders
  To reset the feeders or tray to 'full' of the selected trolley after a splice action. A new window will open with to specify the reset function.
- TRAY SUPPLY: 4.9.1.3.Tray supply
  To set the first pick position in a partial filled tray.
  Only enabled if a tray trolley is selected.
- STORE CARRIER: 4.9.1.4.Store carrier
  Store the carrier of the selected tray trolley section in the storage location.
  Only enabled if a tray trolley is selected.
- DOCK/UNDOCK: 4.9.1.5.Dock / un-dock trolley
  To 'Dock' or 'Undock' the trolleys.
  The button changes with respect to the status of the trolleys
  After activating the button a tray trolley is ready to remove.
  A 'Drop-down list' at each position will appear.
  In the drop down list it is possible to change the trolley type.
- OK: To close the window.

4.9.1.1 Disable / list feeders:

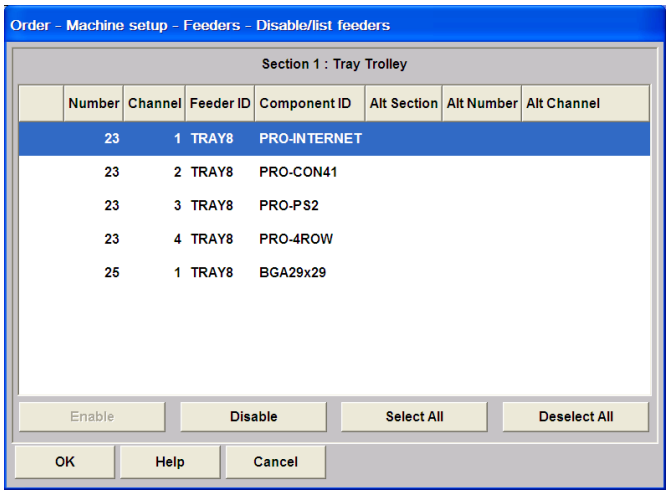

Figure 59

Opens the window to inspect the feeder setup and disable or enable feeders of the selected trolley. Disabling one feeder may cause a number of components not to be placed. The production time is affected by disabling feeders so the production time of the action spec will often decrease.

- All components that must be picked from one particular feeder can be found in the cross reference listings, which can be generated by PPS. This listing can be used to search for these components before disabling particular feeders, so that the impact of disabling is known before starting production.
- When a feeder has been disabled an “X” is shown in front of its line.
- If the user wishes to remove specific component placement instructions from the action spec then the best practice is to modify the product data in PPS and to regenerate the entire action spec with PPS. When required, PPS can maintain the existing feeder setup. It is also possible to edit the existing action spec although this will often take more time than regeneration with PPS, therefore this is not recommended.

4.9.1.2 Reset feeders

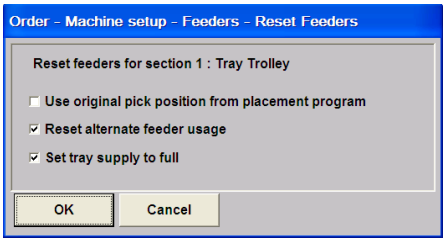

Figure 60

To reset the feeders or tray to 'full' of the selected trolley after a splice action. A new window will open with to specify the reset function.

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4.9.1.3 Tray supply

To set the first pick position in a partial filled tray.
Only enabled if a tray trolley is selected.:

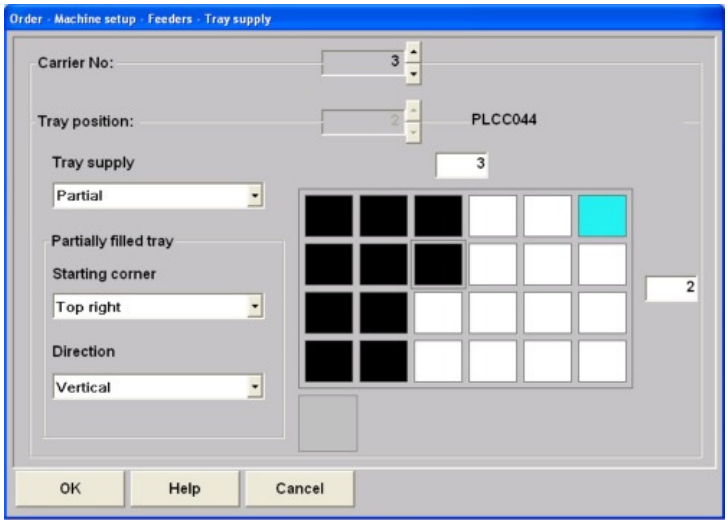

Figure 61

- CARRIER NO: Shows the carrier slot number in which the tray to edit is located.
  - Select UP to go to the next available carrier.
  - Select DOWN to go to the previous available carrier.
- TRAY POSITION: Shows the tray position on the selected carrier including the component name. Only applicable if there are two or more trays configured on the selected carrier.
  - Select UP to go to the next available carrier.
  - Select DOWN to go to the previous available carrier.
- TRAY SUPPLY: To define the amount of components on the selected tray.
  - Full. In case the tray is full.
    The graphical presentation will show a full tray.
  - Partial. In case the tray is not completely filled.
    The graphical presentation will show a full tray.
    Select in the text boxes or on the graphical presentation the first component to pick.
  - Empty. In case the tray is empty.
    The graphical presentation will show an empty tray.

  A graphical presentation of the selected tray. Including number of components in X and Y direction and reference corner.
  Selecting a component on the tray will empty the position.
  Selecting a component on the tray will fill out the text boxes on top and to the right of the picture with the applicable X and Y count on the tray.
- STARTING CORNER: To select the starting corner on the selected tray.
  Available options:
  - Bottom left.
  - Bottom right.
  - Top left.
  - Top right.
- DIRECTION: To select the pick direction on the selected tray.
  Available options:

- Horizontal.
- Vertical.

- OK: To close the window and save all changes.
- CANCEL: To close the window without saving changes.

4.9.1.4 Store carrier

Store the carrier of the selected tray trolley section in the storage location. Only enabled if a tray trolley is selected.

4.9.1.5 Dock / un-dock trolley

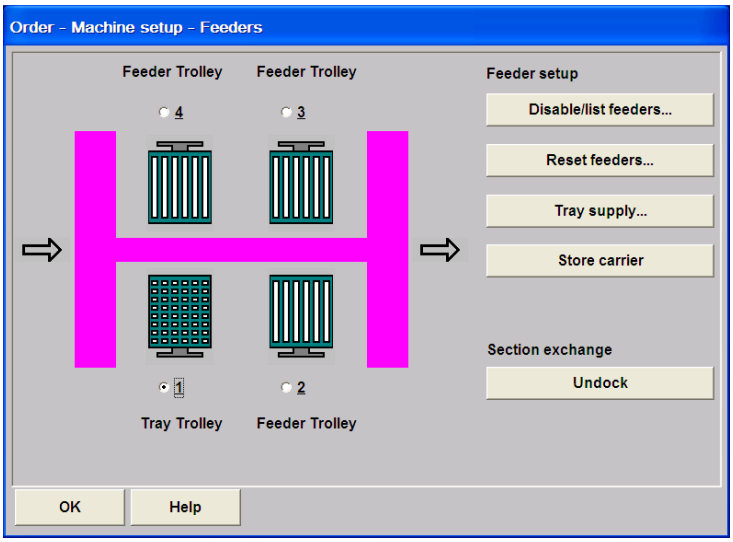

Figure 62

UNDOCK: To 'Dock' or 'Undock' the trolleys.
The button changes with respect to the status of the trolleys.
After activating the button a tray trolley is ready to remove.
A 'Drop-down list' at each position will appear.
In the drop down list it is possible to change the trolley type.

- OK: To close the window.

4.10 Transport, setup

In the 'Programs - Order setup - Transport' screen transport settings can be checked and changed. Each order may require adjustment of the board transport width.

- Ensure that no boards are present in the transport and the machine is stopped, before adjusting the board transport width.

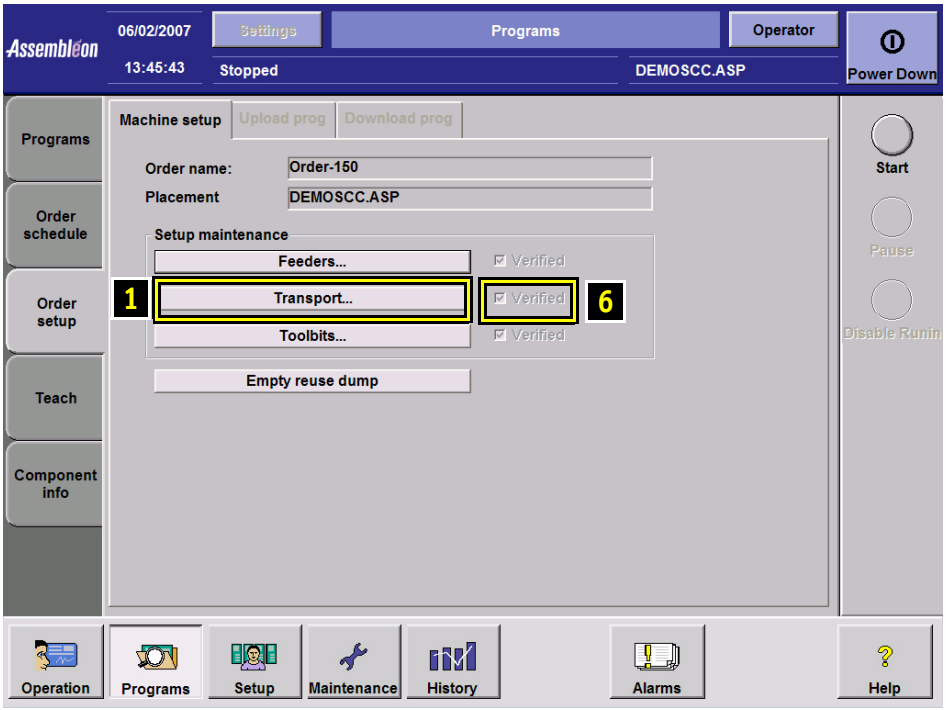

Figure 63 Transport setup

To adjust the transport width:

- Click on “Transport” (1).
- Select “Set to required width” (2) in the transport setup screen.
- When the transport has been adjusted successfully, the 'Verified' check box behind the 'Transport...' button (6) on the machine setup dialogue can be marked.

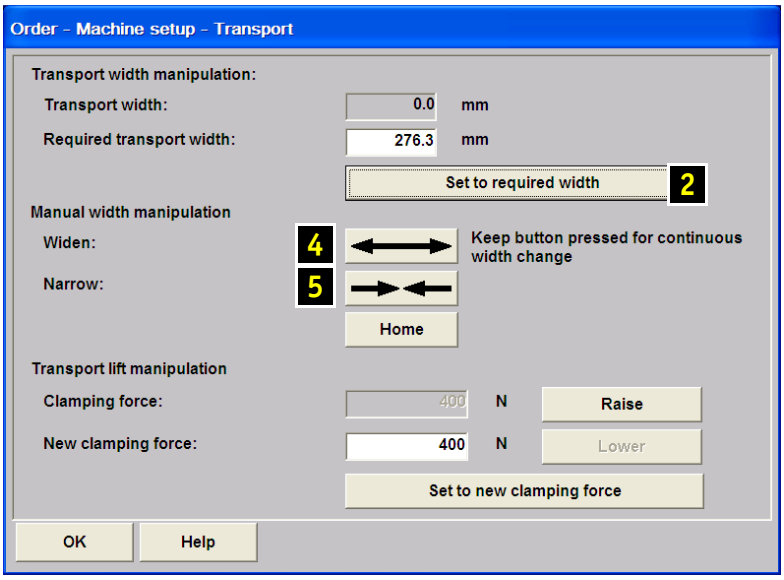

Figure 64

Available settings:

- TRANSPORT WIDTH: Shows the actual width of the transport.
- REQUIRED TRANSPORT WIDTH: Fill out the required width of the transport. The transport will be adjusted to 'board_WIDTH' + 0.85 [mm] (board width is defined in the placement program). A controller warning will be shown after selecting the 'Set to required width' for the first time. If the support pins are removed, selecting 'Set to required width' a second time will carry out the action.
- SET TO REQUIRED WIDTH: To move the transport from the actual to the required width. Only available if the machine is stopped.
  No boards must be in the transport.
- WIDEN: To manually set the transport to a higher width.
- NARROW: To manually set the transport to a smaller width.
- HOME: To home the transport. Only available if the machine is stopped.
  No boards must be in the transport.
- CLAMPING FORCE: Shows the actual clamping force of the transport in newton. This force may have to be reduced for boards in board frames or for very fragile boards.
- NEW CLAMPING FORCE: Fill out the required clamping force of the transport in newton.
- SET TO NEW CLAMPING FORCE: To set the transport from the actual to the new clamping force.
- RAISE: To manually raise the transport to get to a higher clamping force. Disabled when the highest clamping force is reached.
- LOWER: To manually lower the transport to get a lower clamping force. Disabled when the lowest clamping force is reached.
- OK: To close the window and save all changes made.

4.10.1 Transport width, checking

- Check the transport width using a board, fine tune the width using the “widen” or “narrow” (4,5) button if necessary.

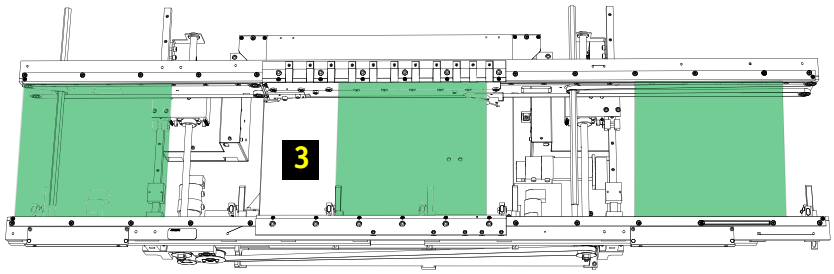

Figure 65 Board support pins

- If necessary, place magnetic support pins (3) to support the board in the work-area.
  The magnetic contact enables easy movement of the pins. It is advisable to mark the required locations for supporting the board on a transparent plate which is held in the work-area of the machine instead of the board. The user can now see if the pins are in the correct position.
- Ensure that the pins do not damage earlier positioned components on the bottom side of the board.

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4.11 Toolbits setup

Each order may require a different set of toolbits.

To check this:

- Make the order running.
- Ensure that no boards are present in the transport and the machine is stopped, before changing the toolbit setup.

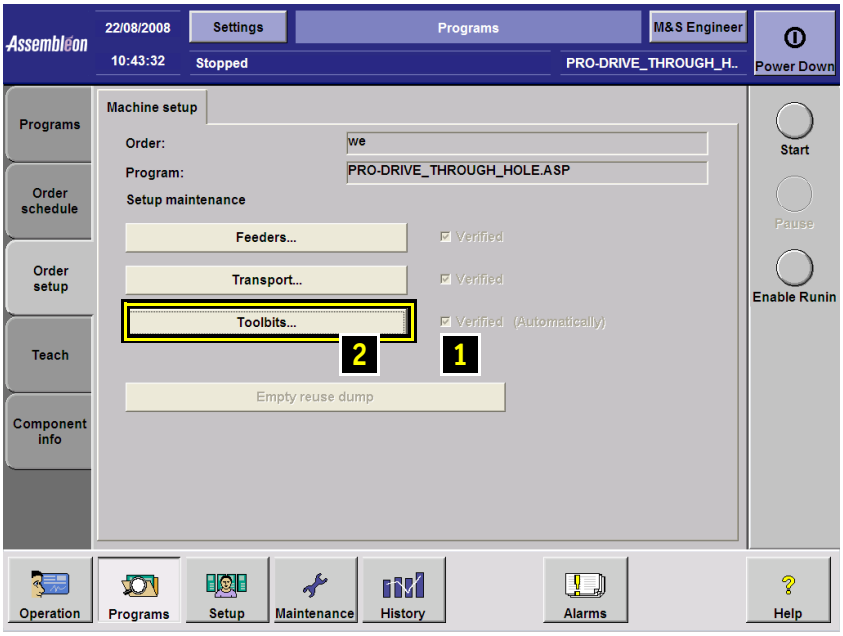

Figure 66 Toolbits setup

If the 'Toolbits' (1) check box is disabled, it is checked automatically.
In case the toolbits check box (1) is not marked:

- Enter the toolbits dialogue (2) in order to make the necessary changes.

4.11.1 Toolbit in placement head, exchange manually

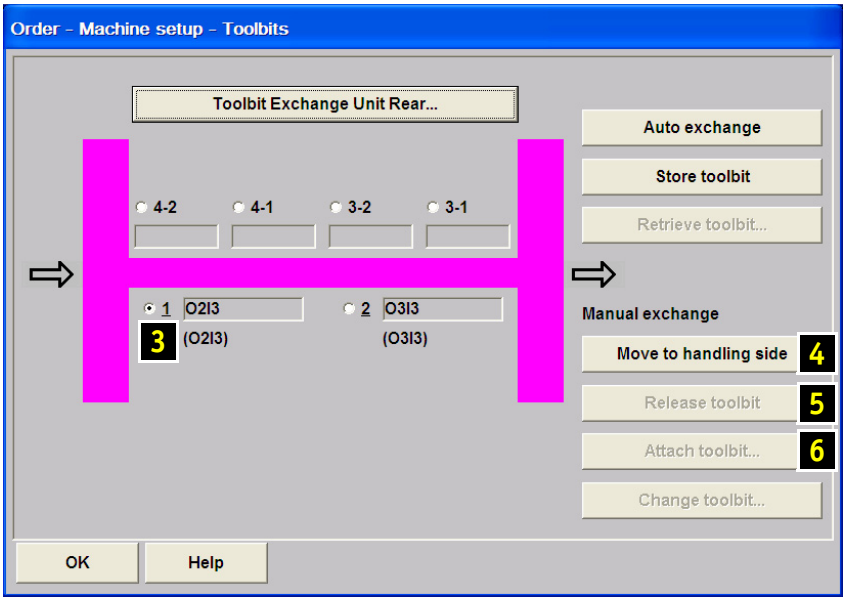

Figure 67 Toolbits setup

- To exchange the toolbits in the placement heads manually, select the applicable head (3) and click on “Move to handling side” (4).
- Open the cover at the specific side of the machine. The servo power will switch off.

If there is still a toolbit in the head, hold it. The toolbit is unlocked in the next step and it would fall down if not held!

- Select “Release toolbit” (5). If there was a toolbit in the head it will be released now. Take the toolbit out and store it in a secure place.
  Toolbits for placement heads DV are kept by magnetic force and must be pulled off by hand.
- A special dialogue appears to select the requested toolbit.
  Select the requested toolbit.
- Insert the toolbit manually into the head. Properly align the toolbit with its fixing hole directed towards the front side.
- Select 'Attach toolbit' (6) the toolbit will then be locked into the head. It is no longer necessary to hold it.

4.11.2 Toolbit in toolbit exchange unit, exchange manually

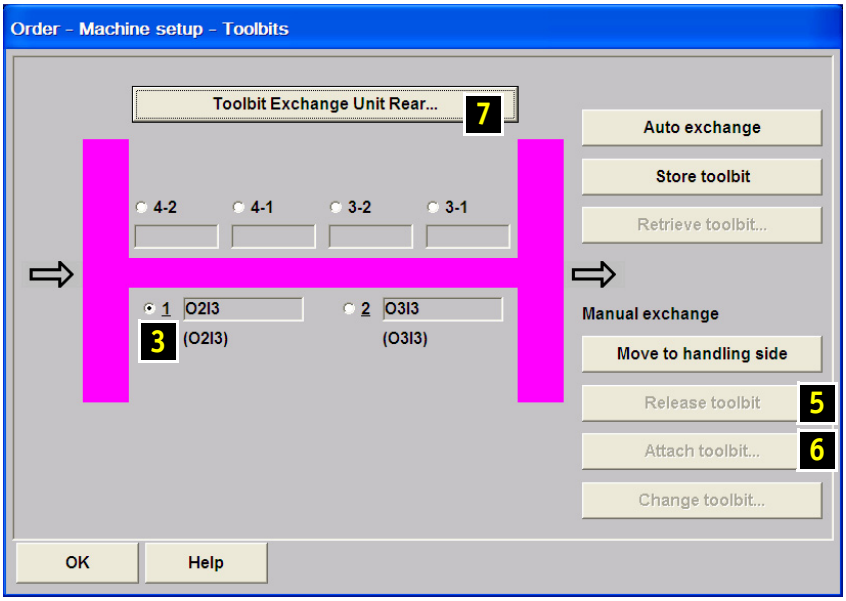

Figure 68

- To exchange the toolbits in the toolbit exchange unit, click on the button "Toolbit exchange unit rear" (7).
  The toolbit exchange unit screen will open:

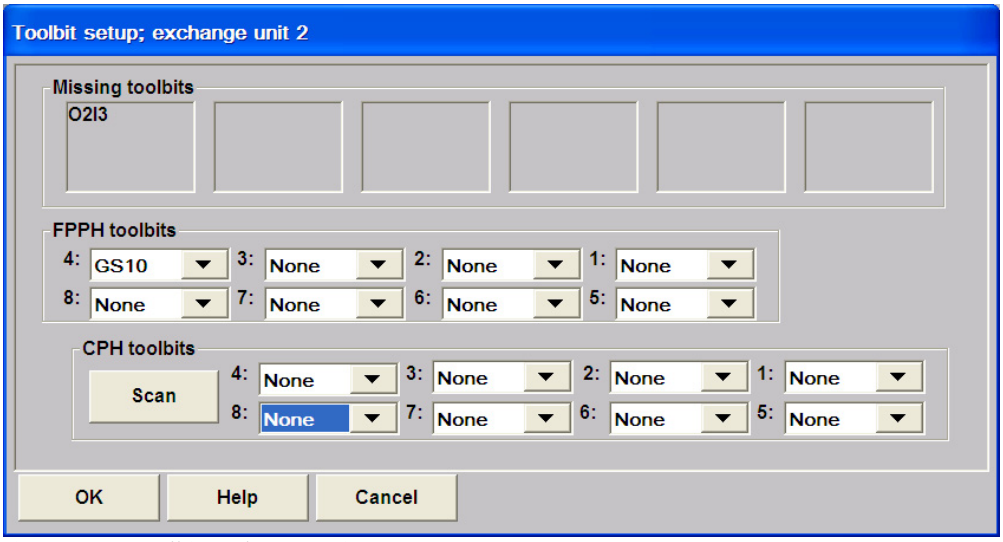

Figure 69 Toolbit exchange unit

6. Repeat 4.11.1.Toolbit in placement head, exchange manually, until all missing toolbits are in the heads.
   When all toolbits have been placed in the heads:
7. Place the required toolbits in the toolbit exchange unit.
8. Select the corresponding toolbits in the toolbit exchange unit screen. This way the system knows the location of the toolbits in the toolbit exchange unit.
9. Confirm the location of the toolbits by clicking on the "OK" button.
10. Tick the 'Verified' check box behind the 'Toolbits...' (1) button on the machine setup dialogue.
11. Close the cover.

CHAPTER 5 Run production

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5.1 Start production

Before production can be started a placement program must be running. The procedures for set-up should be carried out completely. This will result in three marked 'Verified' check boxes on the order setup dialogue see 4.8.Machine setup.

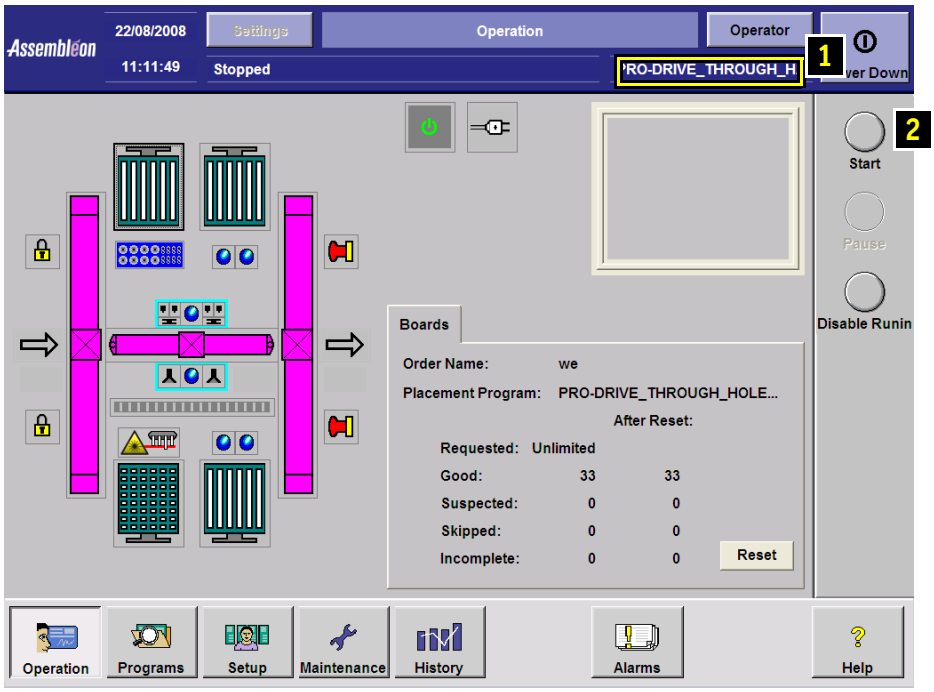


Figure 70

- Check if the order (1) is present.
- Start production by selecting the start button (2).

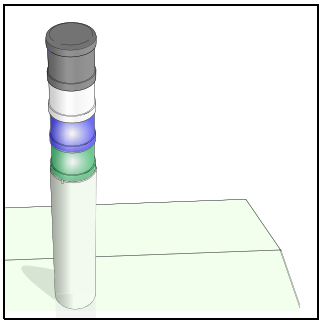
The control buttons (start/Stop, Pause and Disable/Enable run-in) are visible at the right side of the screen at all times.

After successful completion of this action the machine status display will show that the machine is running.

5.2 Monitor production

During production the operator can monitor production as follows:

■ **Lamp post**



Beeper: In case of an error the operator will be warned by an acoustic signal.

White: Emergency activated / machine stopped / idle state.

Blue: Request for operator interference, caused by faulty conditions.

Green: Safe running mode.

Figure 71 Lamp post

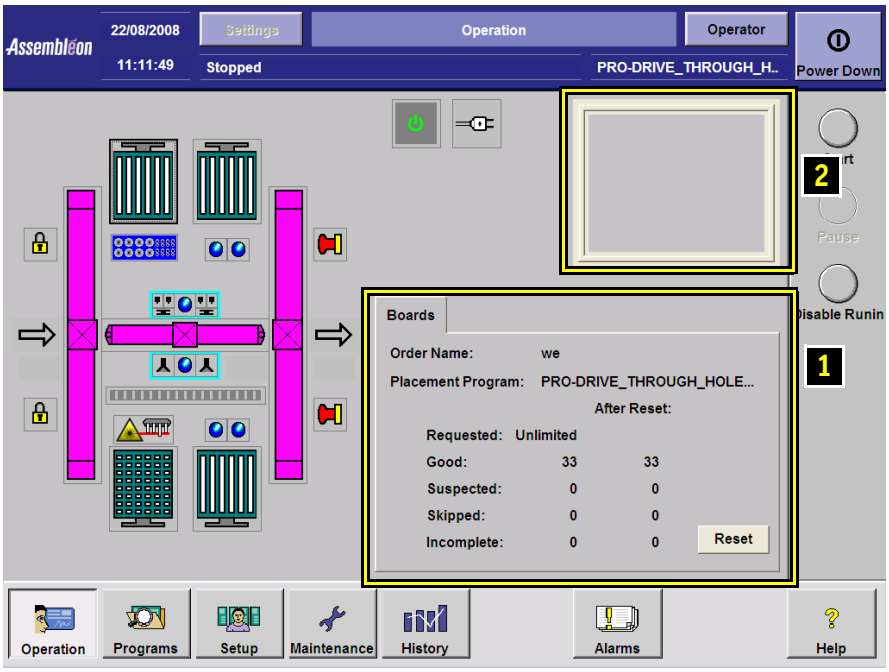


Figure 72 Graphical user interface

■ **User interface (GUI)**, showing:

- The number of good, suspected and skipped boards are displayed (1).
- The camera images are displayed on screen (2).
- Warnings and errors will be displayed when they occur.
- Help is available on screen.
- SVS-pro screen (optional).

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5.3 Stop production

5.3.1 Stop production by aborting the order

Under normal circumstances an order will be completed without stopping. If, for whatever reason, the order can be stopped temporarily. If the order must be stopped before completion abort and delete the order from the order schedule, and remove the boards from the machine.

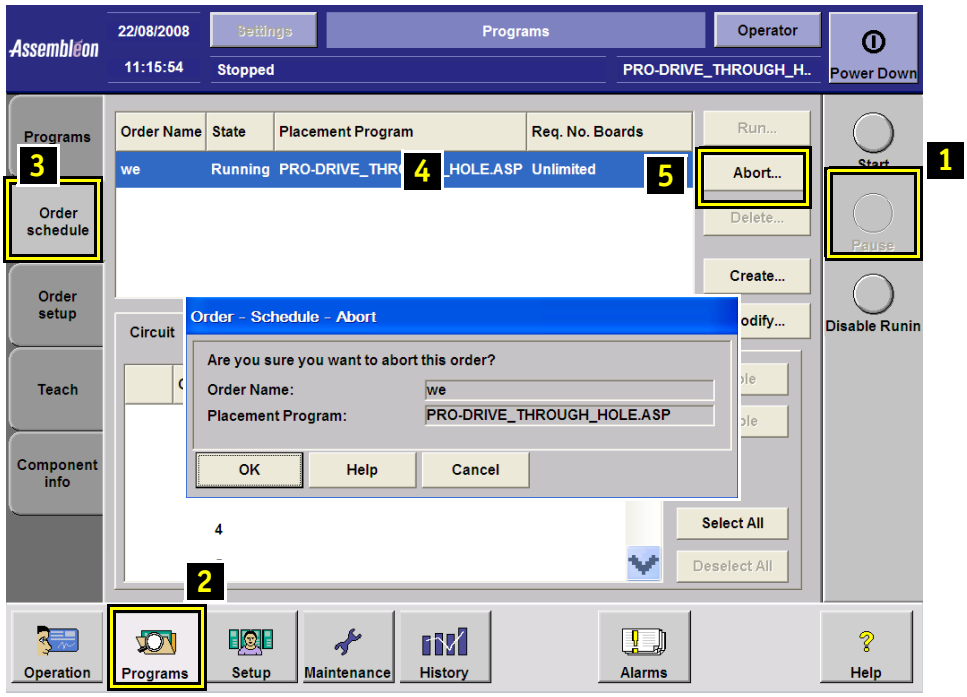

Figure 73 Stop production

To stop production:

1. Press “Pause”.
2. Select “Programs”.
3. Select “Order schedule”.
4. Select the current order.
5. Select “Abort”.
6. When the order is successfully aborted, select “Delete” to remove the order from the schedule.
7. To transport all boards out of the work-area press “Disable run-in” followed by “Start”.

5.4 Pause production

At any time production can be paused.

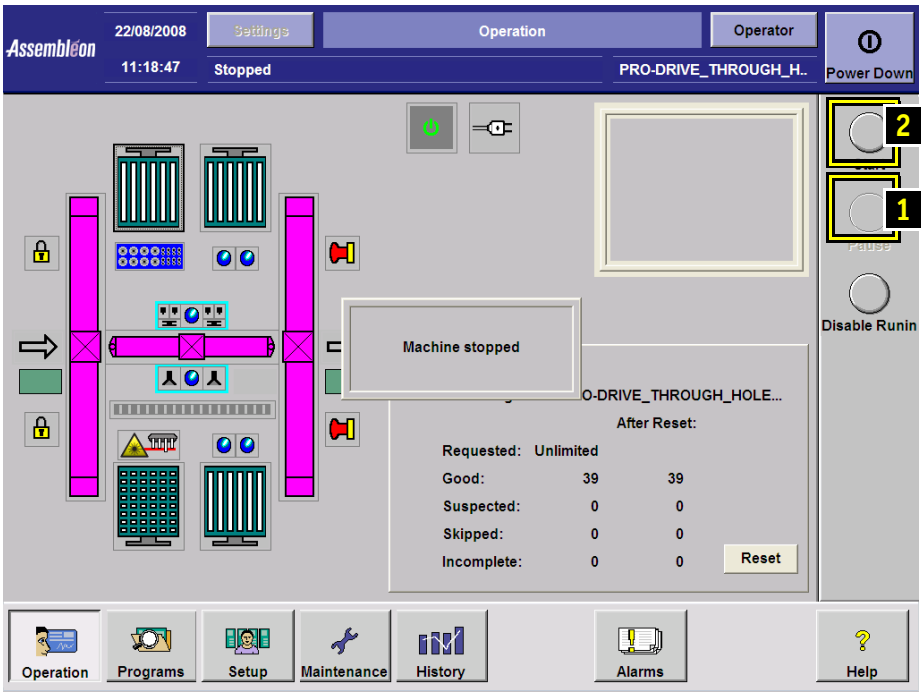

Figure 74

- Select 'Pause' (1).

The current order will stay active. From the pause state the order can be:

- Aborted, see 5.3.Stop production
- Resumed by pressing 'Start' (2).

5.5 Power down the machine

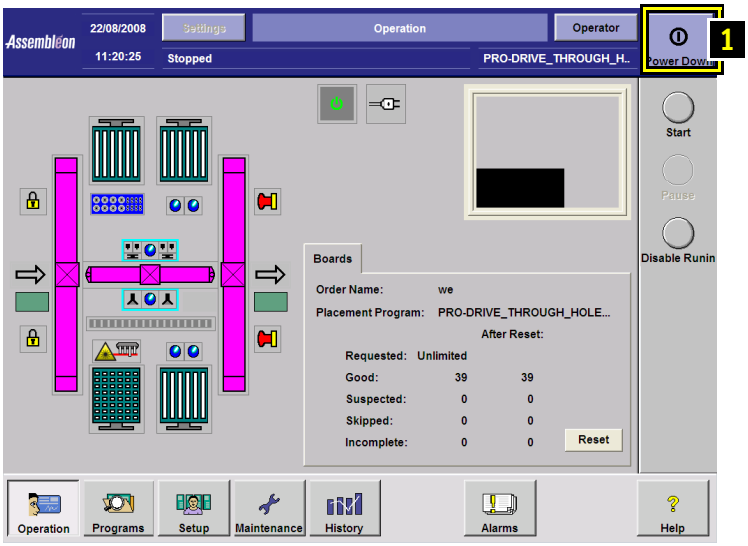

Figure 75 Power down the machine

If a program is running, stop production followed by:

- Press '1' to shutdown the system. Now the shutdown dialogue is presented, where the user is asked to acknowledge the proposed shutdown.

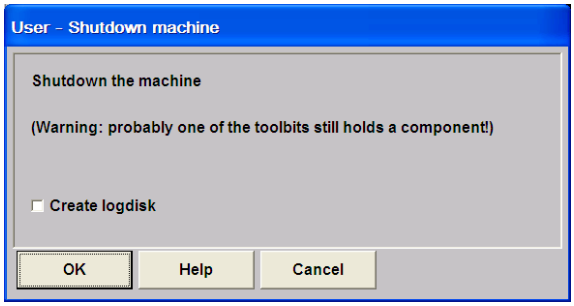

Figure 76 Shut down the machine

Clean the machine before power down, see 4.3.Machine cleaning

CHAPTER 6 Change over production

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6.1 Order change, manual

When the old and new products require a different machine set-up it is not possible to do an automatic order change-over. The machine must run empty before the order for the new board can be entered. The new board is only allowed after the machine set-up has been changed and checked by the operator.

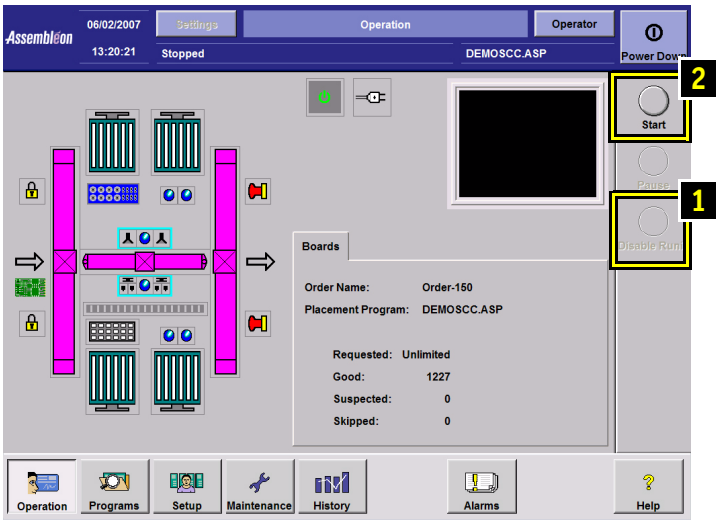

Figure 77 Manual order change

Before a set-up change is carried out all current boards must have left the machine:

- Run the machine empty on the existing order, or
- Select 'Disable run-in' (1), followed by 'Start' (2).
- When the machine has run empty, go to 4.8.Machine setup

6.1.1 Feeder set-up

When the feeder set-up has been changed it might be useful to prepare trolleys before the actual order change-over takes place. As soon as the order is ready, the trolleys can be exchanged quickly.

6.1.2 Transport adjustment

Transport adjustment is not necessary when the successive boards have identical dimensions and clamping force requirements. This will often be the case when board carriers are used or when board frames have been standardized.

6.2 Order change, automatic with barcode triggered change over (BTCO) (optional)

When the old and new boards require identical machine set-up then BTCO is possible. This means that the machine can switch over from the old to the new product without completely running empty.

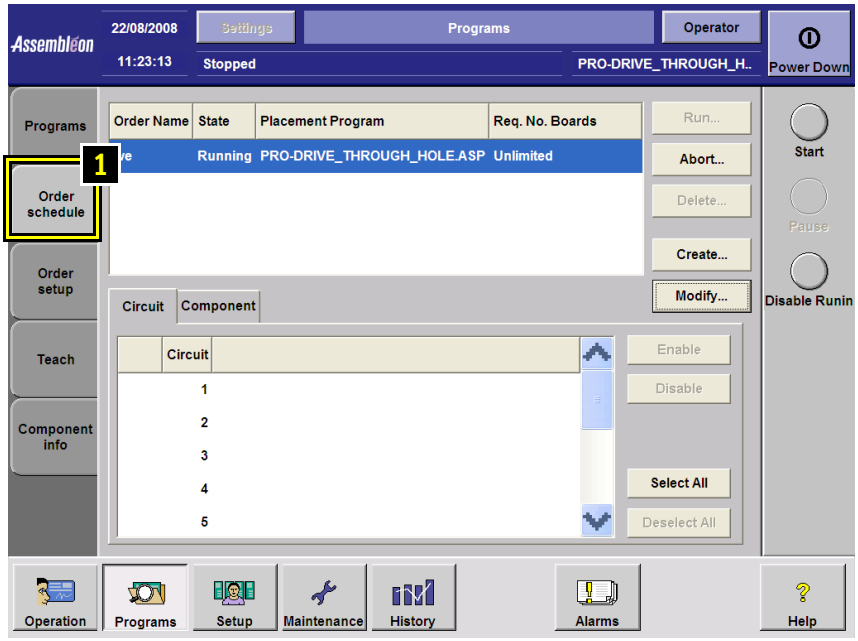

Figure 78 Automatic order change

- Press 'Order schedule'(1). The existing order schedule will now be shown.
- Specify in the order of the 'old' product how many boards have to be processed. The new board must be present at the run-in section exactly after the specified number of old boards has been processed.
- With the 'Modify' button, the order for the new product can be added to the order schedule.
- After the 'OK' button is pressed, the warning dialogue Figure 79 will appear.

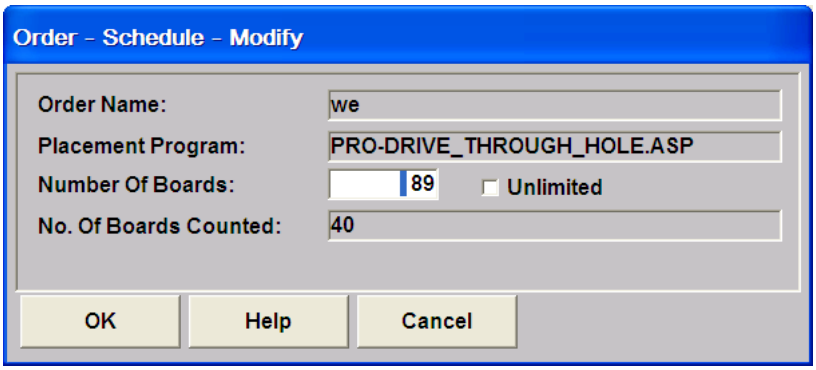

Figure 79 Order schedule- Modify

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CHAPTER 7 Create and correct placement program

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7.1 Placement program handling

7.1.1 Placement program, view/modify

This dialogue can only be accessed by Supervisors or M&S Engineers.

The currently running placement program cannot be edited, just viewed.

NOTE: Modifications that have been carried out partly or incorrectly can cause either illegal or wrong placement programs. Only people with a good understanding of the structure of placement programs may carry out modifications.

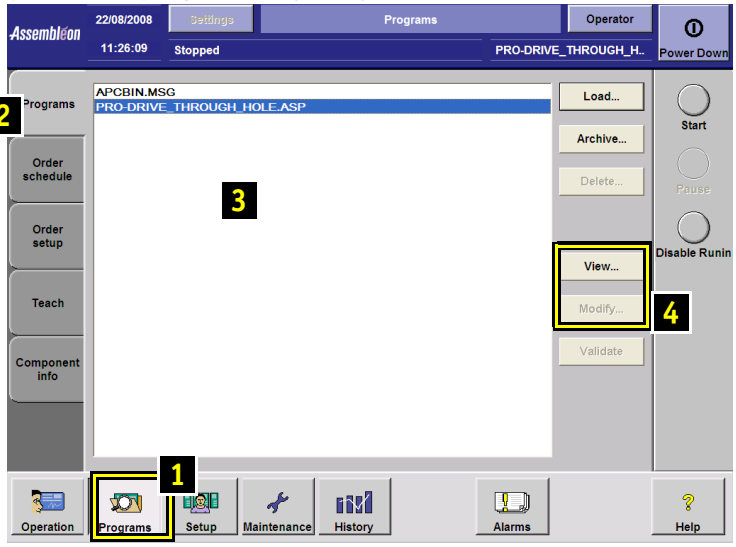

Figure 80 Edit

- Log in as 'Supervisor' or 'M&S Engineers', see 4.4.Log on
- Select 'Programs' (1).
- Select 'Programs' (2).
- Select placement program (3) to be modified or viewed.
- Select 'View' or 'Modify' (4).

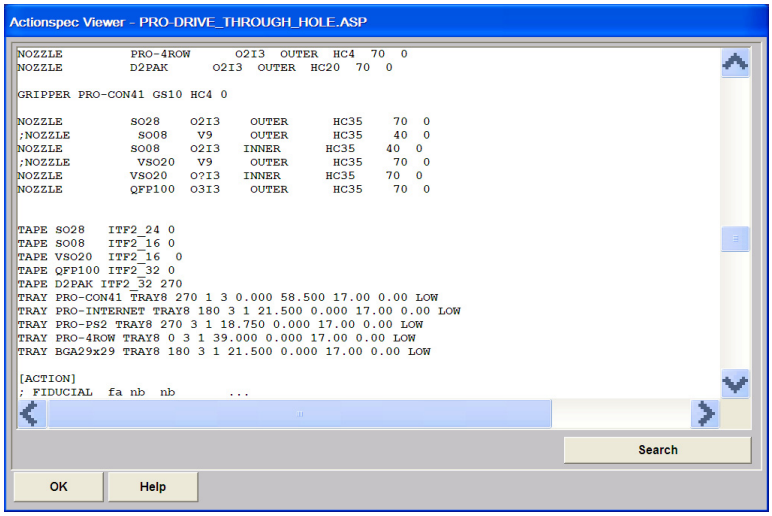

Figure 81 Editor

- Select 'Search and replace'.

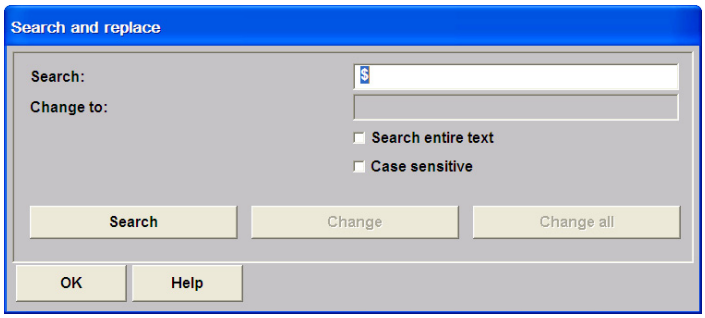

Figure 82 Find, Search and Replace

- Search for '$' to find errors.
- Correct the particular lines
- Go back to 'Validate'.
  Now there will be checked if the placement program will be accepted by the machine in its current configuration.

If errors occur the user will be notified with a dialogue box (Figure 83).

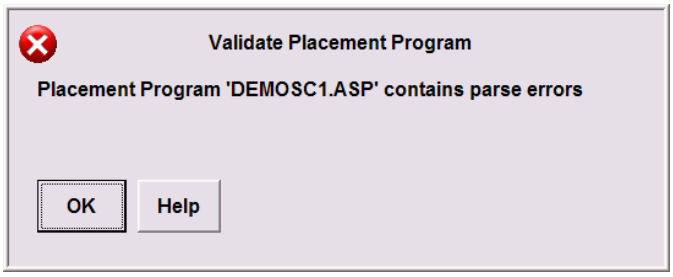

Figure 83 Placement program validate error message box

7.1.2 Placement program, delete

This dialogue is restricted to Supervisors and M&S Engineers only, it can be used to delete one or more placement programs.

NOTE: Deleted placement programs cannot be recovered on this system. It is advised to archive placement programs.

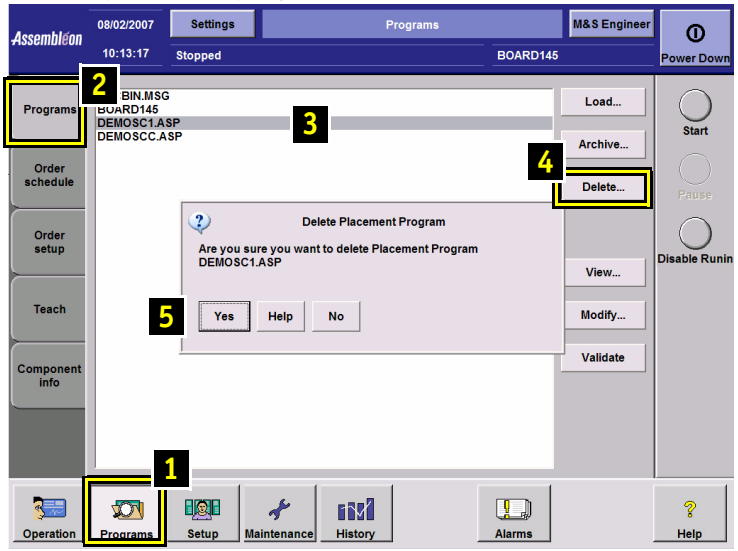

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Figure 84 Deleting placement program

- Log in as 'Supervisor' or 'M&S Engineers', see 4.4.Log on
- Select 'Programs' (1), (2).
- Select placement program (3) to be deleted.
- Select 'Delete' (4).
- Confirm with 'Yes' (5).

7.1.3 Component info

This dialogue provides information on components placed in a particular placement program.

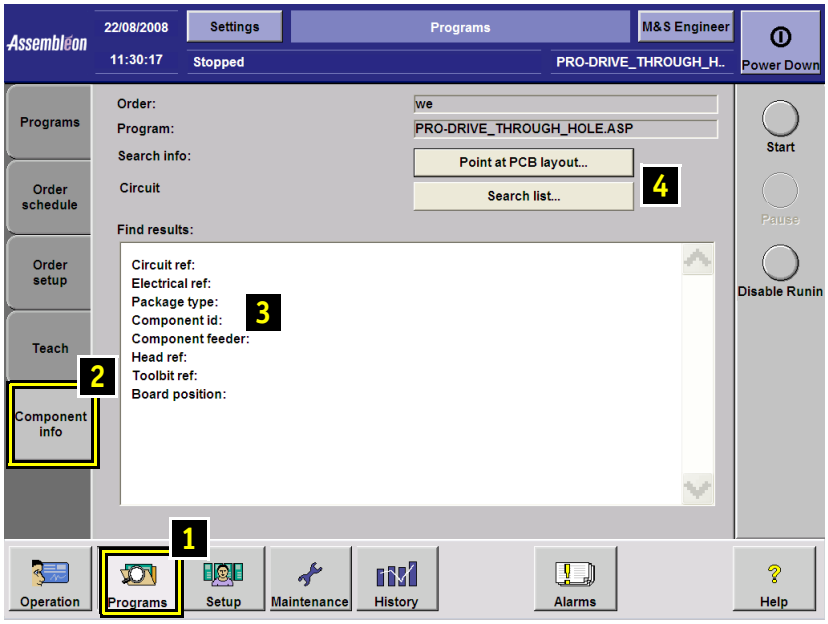

Figure 85 Component Information

- Log in as 'Supervisor' or 'M&S Engineers', see 4.4.Log on
- Select 'Programs' (1).
- Select 'Component info' (2).
- Enter the correct circuit number and the identifier of the electrical reference (3).
- Select 'Search' (4) to retrieve the required data.

7.1.4 Placement program, loading

A placement program can be loaded from any source.

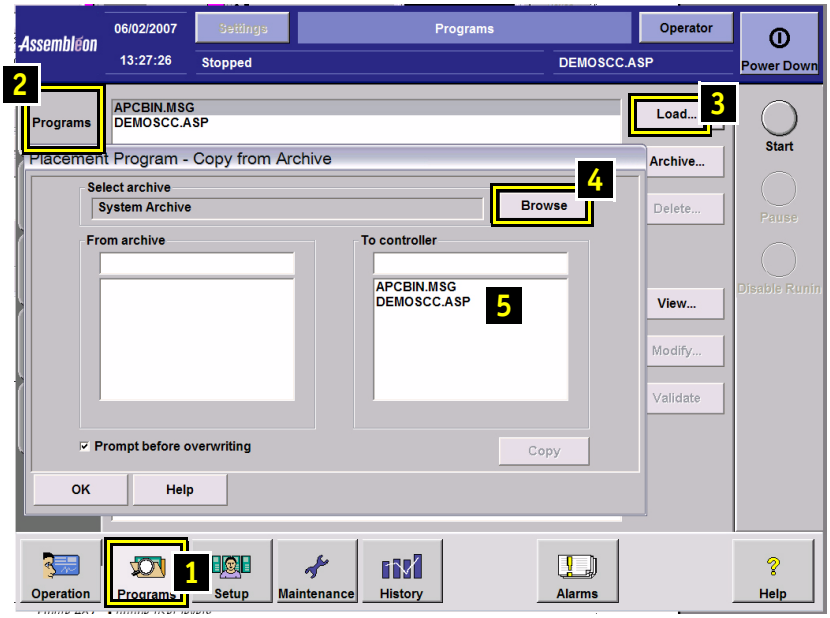

Figure 86 Copy placement program From Archive to Controller

- Select 'Programs'(1,2).
- Select 'Load' (3).
- Select 'Browse' (4) to load a placement program (5) from any source.

7.1.5 Placement program, archiving

This dialogue is used to store a placement program.

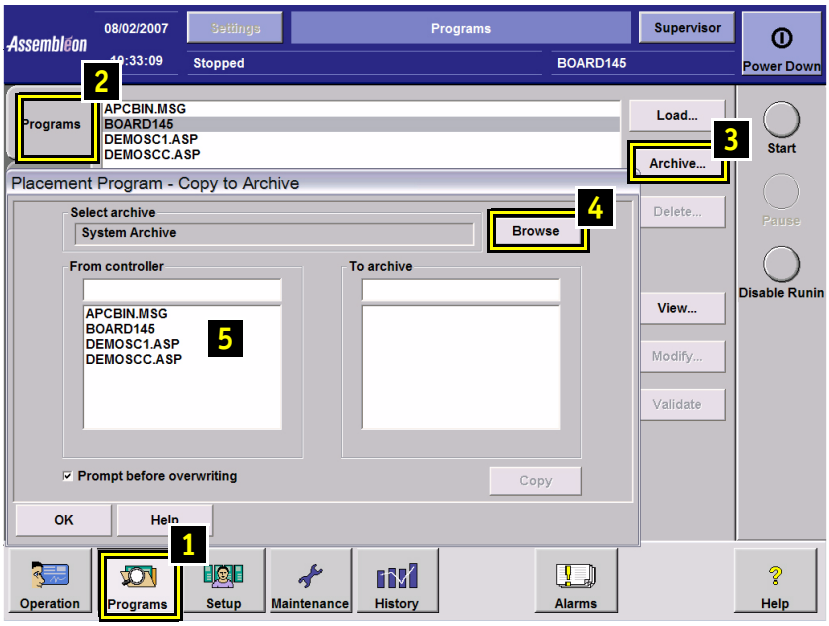

Figure 87 Placement program, archiving

- Select 'Programs' (1,2).
- Select 'Archive' (3).
- Select 'Browse' (4) to store a placement program (5) on any source.

7.2 Placement program, testing

7.2.0.1 Placement program, viewing

This dialogue can be used to view the text of a selected placement program.

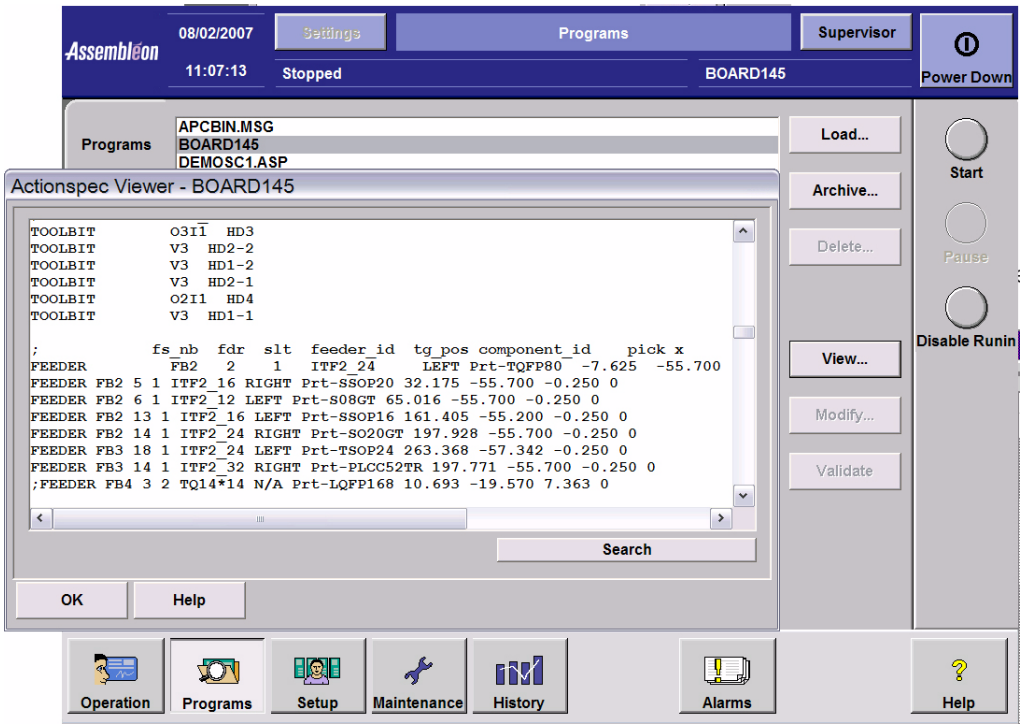

Figure 88 Selection of placement program

After selecting the placement program, the system placement program viewer will be started.

In the placement program viewer the 'Search' button can be used to search for texts or error messages (Figure 89). When the creation of an order with a particular placement program fails the viewer can be started by the operator. All error messages that have been generated during the attempt to create the order will start with a dollar ($) sign. This is also the default character that will be presented in the search dialogue. When the search action is started from the viewer it is not possible to change data in the placement program, therefore the related buttons on the search dialogue will be not accessible and will be dimmed.

Figure 89 Search function in placement program viewer

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7.3 Teaching pick and place positions

NOTE: The teached positions will only be valid if they are saved in the placement program

In this dialogue the user can change the pick positions of feeders (Figure 91). The modifications are entered as differences from the existing pick positions. Visual inspection can help to check if the pick-up coordinates of a particular feeder are correct.

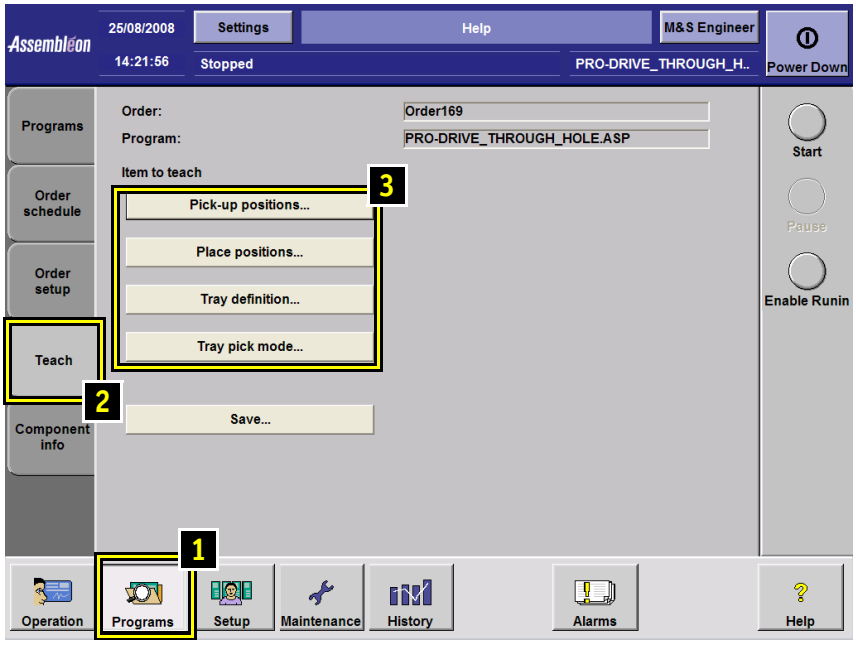

Figure 90 Pick positions, teaching

- Select 'Programs' (1).
- Select 'Teach' (2).
- Select item to teach (3):
  - Pick-up positions, see 7.3.1.Pick-up positions, teaching
  - Place positions, see 7.3.2.Place positions, teaching
  - Tray definitions, see 7.3.3.Pick positions in tray, setting
  - Tray pick mode, see 7.3.4.Pick position in tray, setting start position

7.3.1 Pick-up positions, teaching

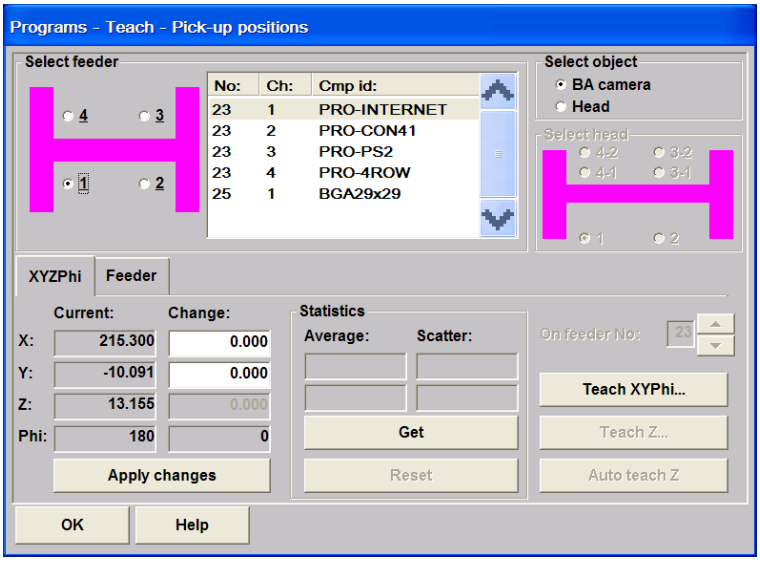

Figure 91 Teach - Pick Positions Dialogue

Take care with the teach function because an undo function is not available. This function is intended for exceptional situations (such as using odd components) under normal conditions. It should not be used to change action specifications since this can be done offline with PPS.

With this screen the user can select a feeder and change the pick-up coordinates of that feeder. The modifications are entered in the Change column as differences from the Current pick positions.

The description of the input fields is as follows:

FIELD/BUTTON	DESCRIPTION
Select feeder section	Select the feeder for which the pick positions have to be changed
No: Ch: component	
Teach - Select object	Select BA camera or head. With a camera it is possible to get an image of the pick-up area on the screen
Pick-up coordinates - current	The coordinates of the feeder pick-up positions
Pick-up coordinates - Change	Field for entering offset values
Pick-up coordinates - New	
<Change coordinates>	Add/subtract the offset values to the current coordinates
Statistics - Average	The average offset which has been measured by the CV camera
Statistics - Scatter	The scatter which has been measured by the CV camera
<Get>	Fills in values for Average and Scatter based on recent machine performance (measurements have been performed with CV camera)
<Reset>	Reset last statistical data
<Teach XY>	See 7.3.1.1.Pick position in XY direction, teaching with the BA camera 7.3.1.2.Pick position in XY direction, teaching with a head
<Teach Z>	See 7.3.1.3.Pick position in Z direction, teaching with a head
<Auto teach Z>	See 7.3.1.4.Pick position in Z direction, auto teach with a head for gripper or outer nozzle

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Figure 92 Teach pick position input fields

It is possible to teach a new position with the help of the ‘move to feeder’ button as follows:

7.3.1.1 Pick position in XY direction, teaching with the BA camera

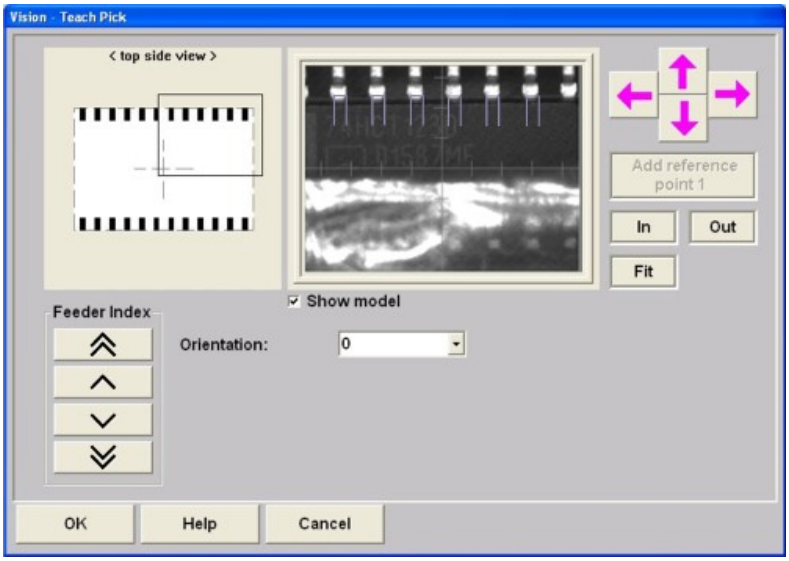

Figure 93

In the 'Program' - 'Teach' - 'Pick-up Position' - 'Teach XYPhi' screen the pick position can be set. It is done with help of the live image and model view.

- TOP SIDE VIEW: Shows the model of the applicable component from the top. If the component is bigger than the area of interest of the camera, a black square is visible. It represents the part of the model that is visible in the camera image.
  Touching the screen will move the area of interest and the position of the applicable camera above the components pick position.
- CAMERA IMAGE: Shows the image of the applicable camera.
- JOG: To jog with the camera over the pick position.
- ADD REFERENCE POINT: To add a reference point.
  After adding a reference point the number will increase.
  Reference points are used to help with picking a component in case the features are to small or not visible.
- IN: To zoom in the camera image.
- OUT: To zoom out the camera image.
- FIT: To fit the camera image in the screen.
- SHOW MODEL: To add the model of the component into the camera image.
- ORIENTATION: To change the orientation of the model in degrees.
  Available orientations are 0, 90, 180 and 270 degrees.
- FEEDER INDEX: Only available with remote feeder index enabled.
  Select for continuous indexing forward.
  Select for one feeder index step forward.
  Select for one feeder index step backward.
  Select for continuous indexing backward.
- OK: To close the window and add the changes in the previous screen.
- CANCEL: To close the window without adding changes.

7.3.1.2 Pick position in XY direction, teaching with a head

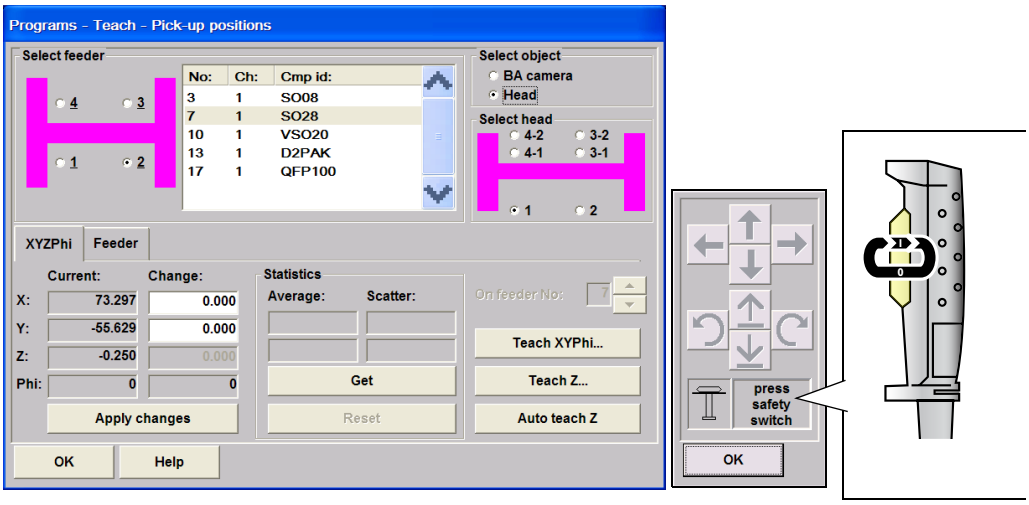

Figure 94

1. Select the feeder (section and feeder/channel) that needs to have its XY position teached.
2. Select the 'Head' as teach object.
   In the 'Teach' mode you can now carry out a Teach XY, a Teach Z (only M&S personnel for outer nozzles and grippers, always for inner nozzles) or an Auto teach Z (only for outer nozzles and grippers).
3. In Select Head, select the head with which the component is picked.
4. Press Teach XY
   The selected head will now be sent to a position 5mm over the current pick position. For grippers this height is w.r.t. the bottom side of the jaws. The servo X, Y keys are enabled so that the user can move the head exactly over the pick-up point. The servo Z keys are also enabled but they are only meant to make it easier to move in XY direction (see Figure 94).
   Only the entry fields for X and Y are enabled in the pick-up coordinates Change column.
5. Keep the enabling switch pressed halfway (see 3.7.1.Enabling switch front/rear, usage), and open the hood for visual inspection.

CAUTION: Never enter the machine, when the enabling switch is operated

6. When releasing the servo keys:
   The pick-up correction window remains active and the Change column shows the difference w.r.t. the current pick-up position.
7. By pressing Change coordinates, the XY result of the Change column is implemented and placed in the Current column. The Change column is then reset to 0.0.

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7.3.1.3 Pick position in Z direction, teaching with a head

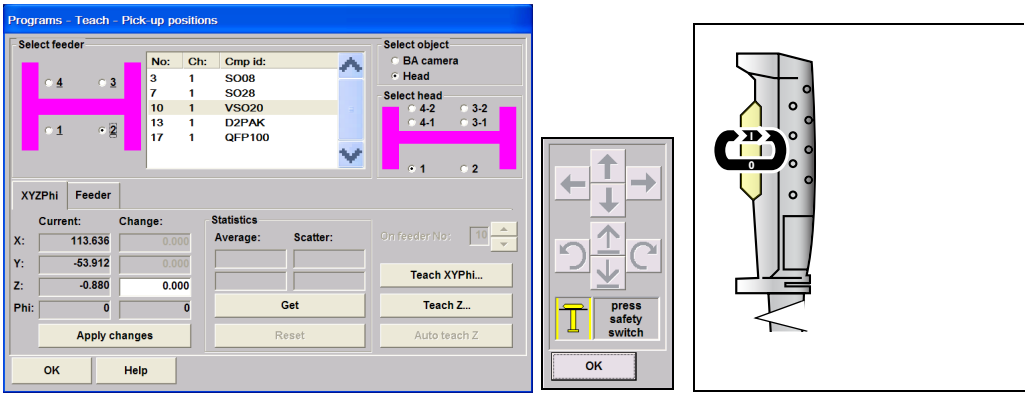

Figure 95

1. Select the feeder (section and feeder/channel) that needs to have its Z-position teached.
2. Select the Head as teach object.
   In the 'Teach' mode you can now carry out a Teach XY, a Teach Z (only M&S personnel for outer nozzles and grippers, always for inner nozzles) or an Auto teach Z (only for outer nozzles and grippers).
3. In Select Head, select the head with which the component is picked.
4. Press Teach Z
   The head will now be sent to the current pick-up position and the servo Z keys will be enabled. The user can now adjust the pick height with the servo keys (see Figure 95). To give the user a better view the BA camera light is activated.
   Only the entry field for Z is enabled in the pick-up coordinates Change column.
5. Keep the enabling switch pressed halfway (see 3.7.1.Enabling switch front/rear, usage), and open the hood for visual inspection.

CAUTION: Never enter the machine, when the enabling switch is operated

6. When releasing the servo keys:
   The pick-up correction window remains active and the Change Z field shows the difference w.r.t. the current pick-up position.
7. By pressing Change coordinates, the Z result of the Change column is implemented and placed in the Current column. The Change column is then reset to 0.0.

7.3.1.4 Pick position in Z direction, auto teach with a head for gripper or outer nozzle

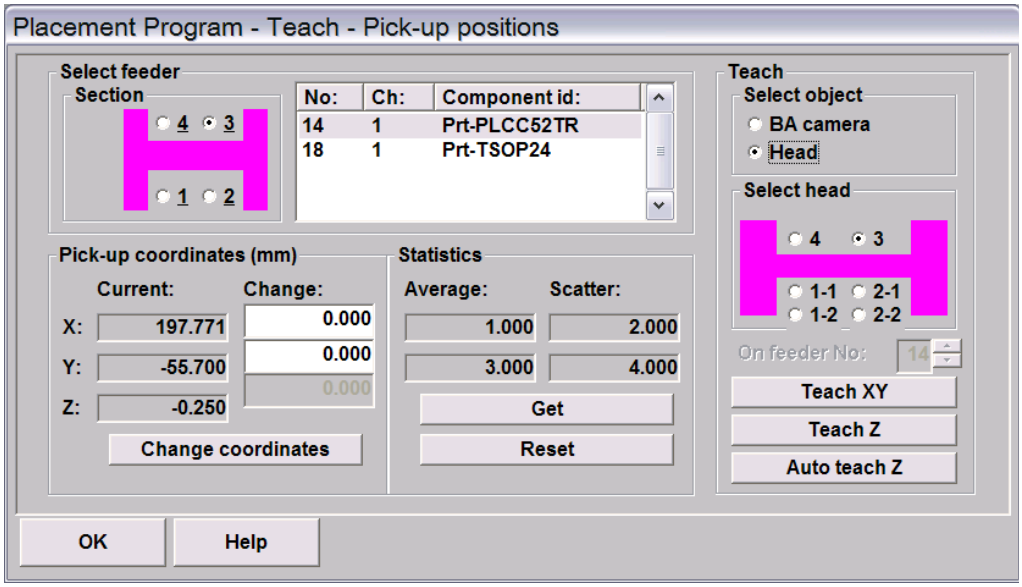

Figure 96

1. Select the feeder (section and feeder/channel) that needs to have its Z-position teached.
2. Select the Head as teach object.
   In the 'Teach' mode you can now carry out a Teach XY, a Teach Z (only M&S personnel for outer nozzles and grippers, always for inner nozzles) or an Auto teach Z (only for outer nozzles and grippers).
3. In Select Head, select the head with which the component is picked.
4. Press Auto Teach Z
   The head will now be sent to a position (15mm) over the current pick-up position. From this position the head will go down at 'collision speed' until a collision is detected. The difference in Z position that is found is displayed in the Change Z field.
   Only the entry field for Z is enabled in the pick-up coordinates Change column.
5. By pressing Change coordinates, the Z result of the Change column is implemented and placed in the Current column. The Change column is then reset to 0.0.

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7.3.2 Place positions, teaching

In this screen a specific component place position can be defined.

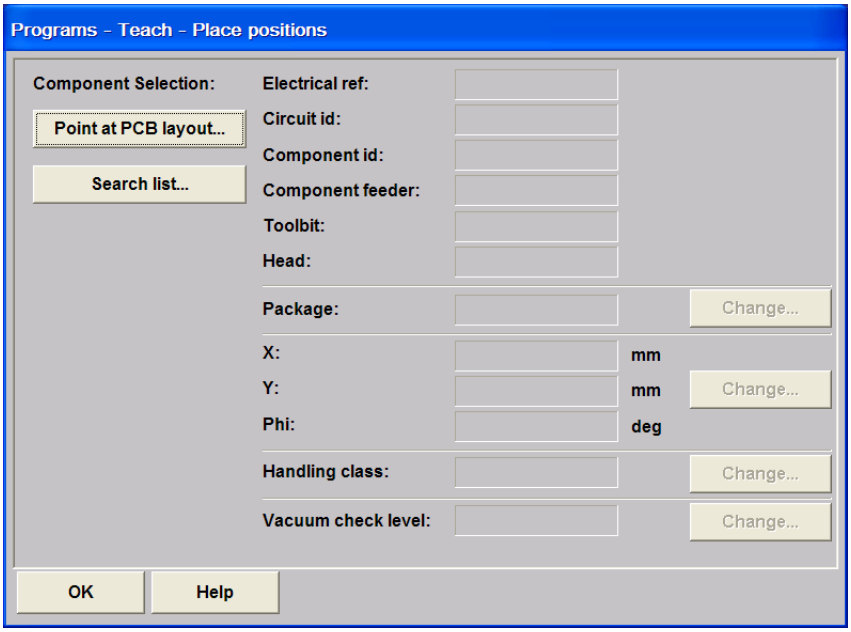

Figure 97

- COMPONENT SELECTION: Shows the selected component parameters.
- POINT AT PCB LAYOUT: To select a component from a visual of the used PCB. A new window will open to select the applicable component.
- SEARCH LIST: To select a component from a list of all used components in the placement program.
  A new window will open to select the applicable component.
- CHANGE: To change the applicable parameter of the selected component.
  A new window will open to make the change.

Only available as maintenance and service engineer.

An undo function is not available. Changes made will be effective.

- OK: To close the window and save all changes to the order-placement program relation.

7.3.3 Pick positions in tray, setting

This screen provides an overview of all trays from the order-placement program relation.

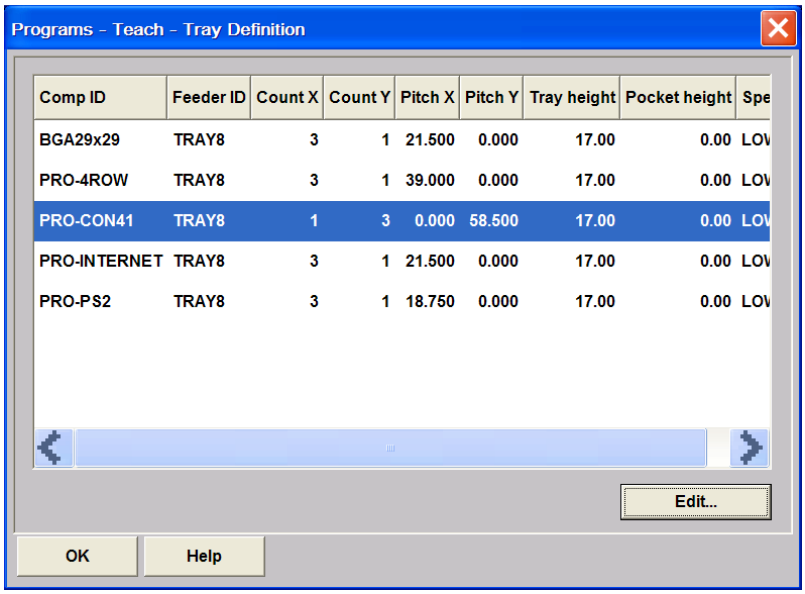

Figure 98

Select one of the tray definitions to edit.Available tray information:

- Component ID.
- Feeder ID, slot number of the tray.
- Count X, number of components in X direction.
- Count Y, number of components in Y direction.
- Pitch X
- Pitch Y
- Tray height
- Speed, transport speed of the tray.

Only one tray can be selected.

Selecting a tray will de-select the previous tray.

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Selecting a column header will sort the list.

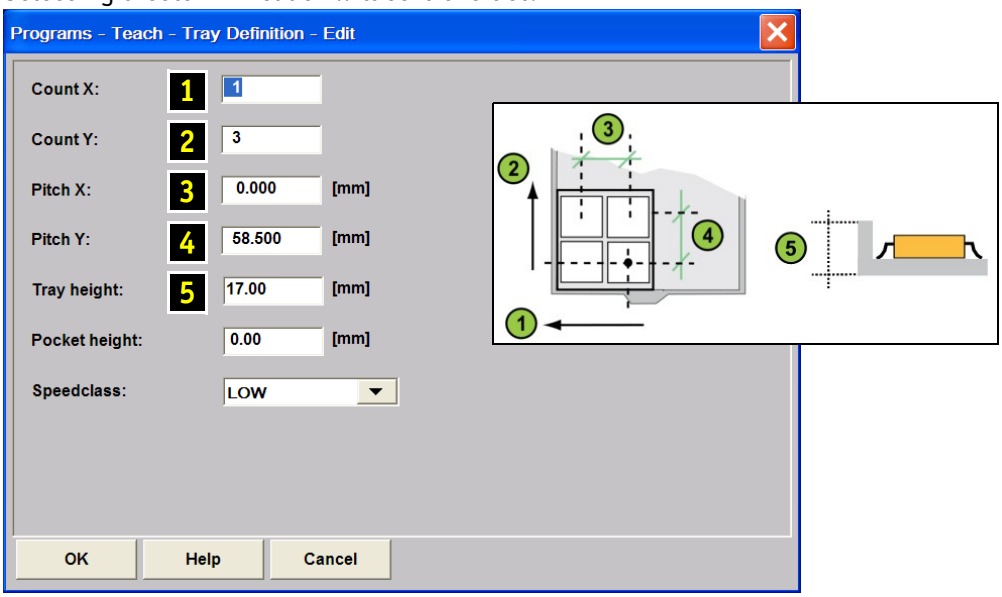

Figure 99

- EDIT: To open the edit window and change the tray layout of the selected tray
- OK: To close the window and show the selected component in the previous screen.
- CANCEL: To close the window without changes.

7.3.4 Pick position in tray, setting start position

In this screen the pick direction and starting corner can be set for all trays in the running order - program relation.

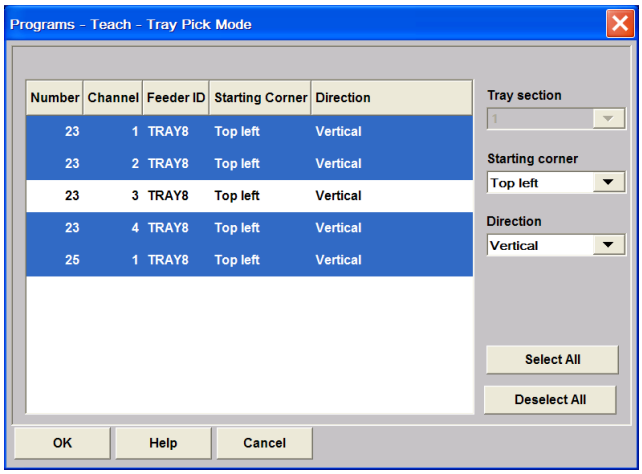

Figure 100

Select one of the tray definitions to make the settings.

List of all trays from the placement program.

- Number, of the carrier where the tray is located.
- Channel, of the tray on the carrier.
- Feeder ID, name of the used carrier.
- Starting corner.
- Direction.

Selecting a column header will sort the list.

- STARTING CORNER: To select the starting corner on the selected tray.
  - Available options:
  - Bottom left.
  - Bottom right.
  - Top left.
  - Top right.
- DIRECTION: To select the pick direction on the selected tray.
  Available options:
  - Horizontal.
  - Vertical.
- SELECT ALL: To select all trays from the list.
- DESELECT ALL: To de-select all selected trays.
- OK: To close the window and save the changes.
- CANCEL: To close the window without changes.

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7.4 Place positions, teaching

NOTE: The teached positions will only be valid if they are saved in the placement program.

In this dialogue the user can change the place positions of components (Figure 101).

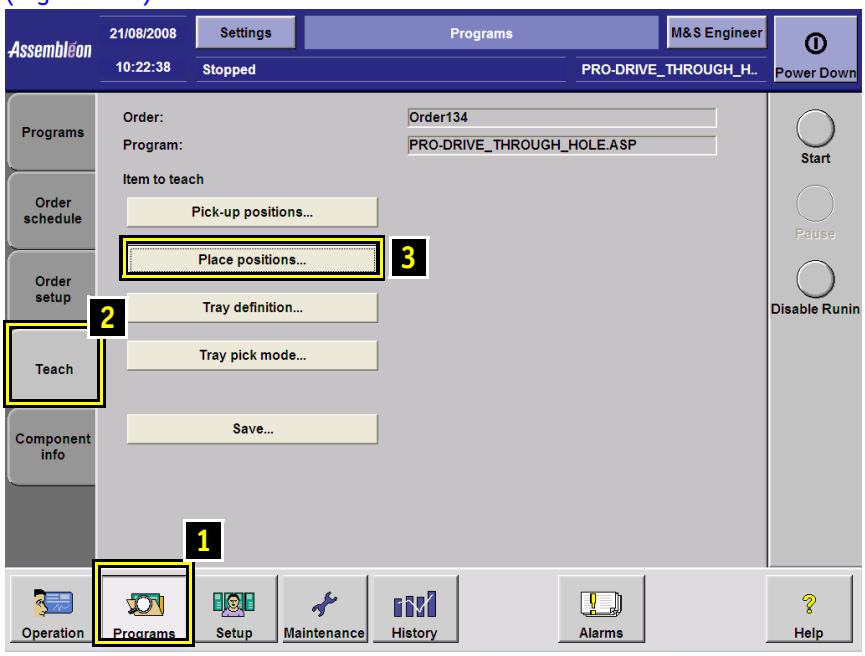


Figure 101 Teach place positions

- Select 'Program' (1).
- Select 'Teach' (2).
- Select 'Place positions' (3).

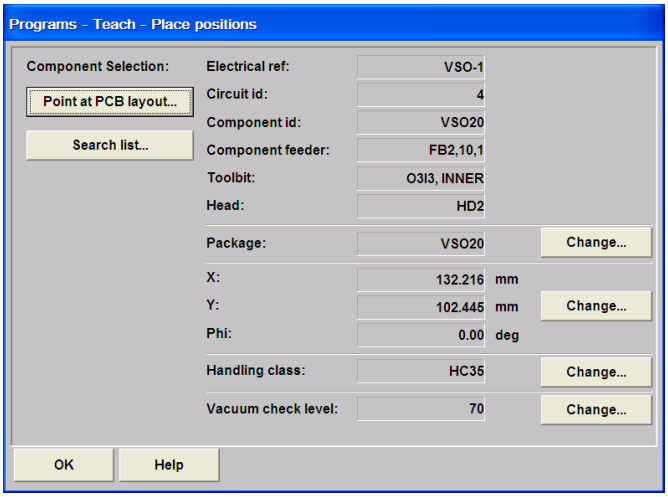
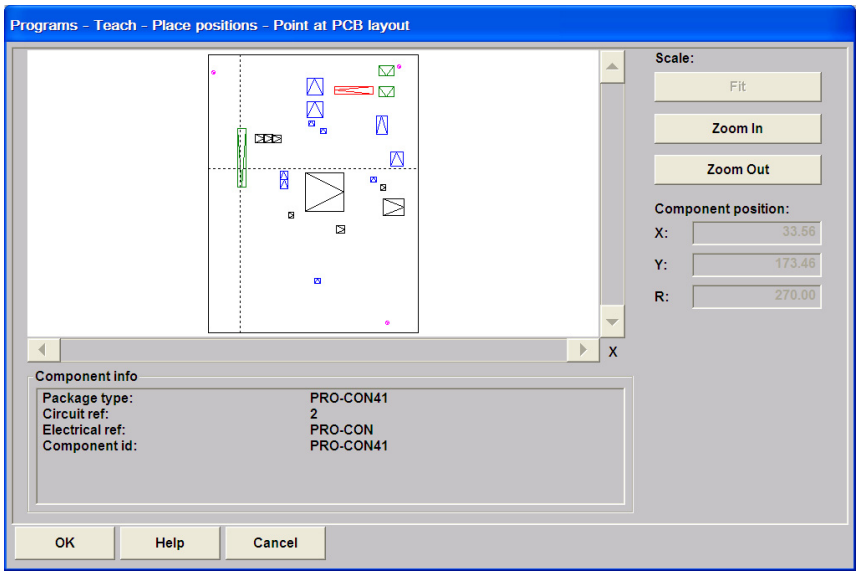


Figure 102 Teach place positions

Specific component place positions can be defined here.

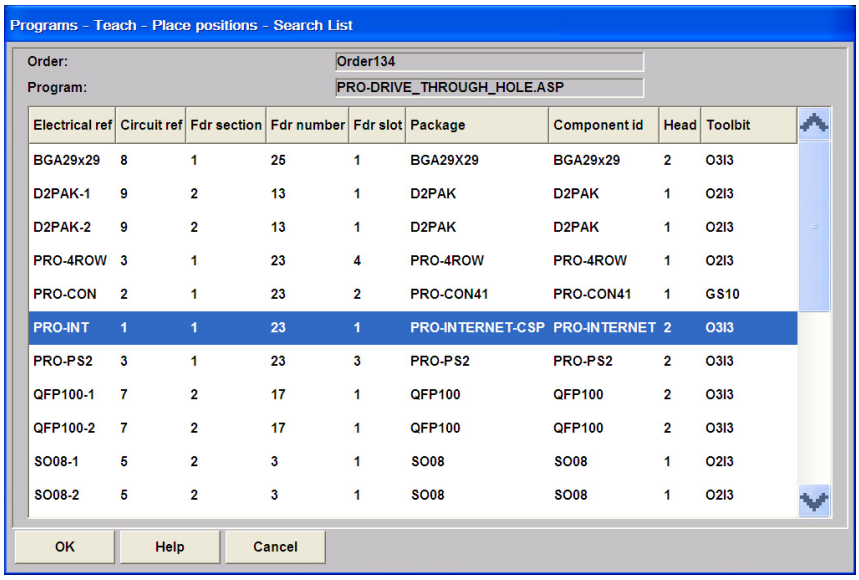
■ COMPONENT SELECTION: Shows the selected component parameters.

- POINT AT PCB LAYOUT:



- To select a component from a visual of the used PCB.
  A new window will open to select the applicable component.

■ SEARCH LIST:



To select a component from a list of all used components in the placement program. A new window will open to select the applicable component.

■ CHANGE (Package, handling class): To change the applicable parameter of the selected component.A new window will open to make the change.

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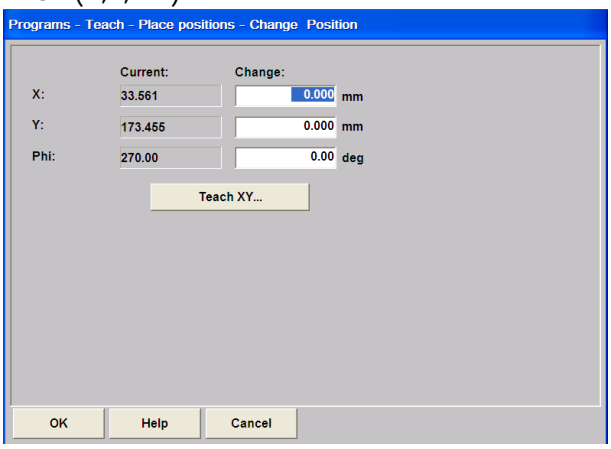
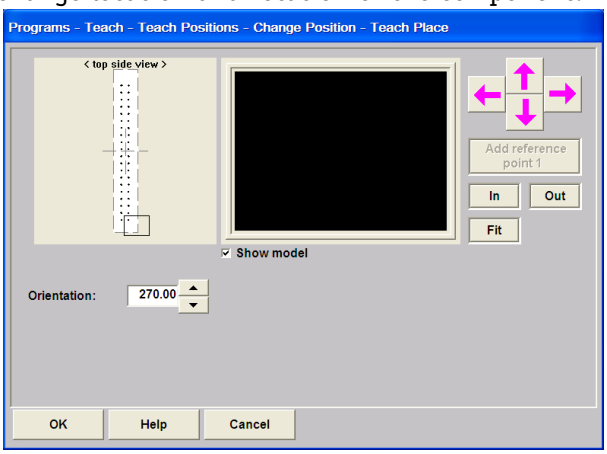
■ CHANGE (X,Y,Phi)



To change location and rotation of the component.



- TOP SIDE VIEW: Shows the model of the applicable component from the top. If the component is bigger than the area of interest of the camera, a black square is visible. It represents the part of the model that is visible in the camera image. Touching the screen will move the area of interest and the position of the applicable camera above the component.
- CAMERA IMAGE: Shows the image of the applicable camera.
- JOG (left, right, up, down): To jog the camera over the place position.
- ADD REFERENCE POINT: To add a reference point.
  After adding a reference point the number will increase.
  Reference points are used to help with aligning a component in case the features are to small.
- IN: To zoom in the camera image.
- OUT: To zoom out the camera image.
- FIT: To fit the camera image in the screen.
- SHOW MODEL: To add the model of the component into the camera image.
- ORIENTATION: To change the orientation of the model in degrees.
  Select to increase the value and turn the model counter clockwise.
  Select to decrease the value and turn the model clockwise.
- OK: To close the window and add the changes in the previous screen.
- CANCEL: To close the window without adding changes.

Only available as maintenance and service engineer.
An undo function is not available. Changes made will be effective. OK: To close the window and save all changes to the order-placement program relation.

The modifications are entered as differences from the nominal place positions.

- Select ‘point at PCB’. The exact position of the components on the board and their coordinates is shown (Figure 98).

7.5 Placement program format

7.5.1 Structure

The placement program consists of blocks. These blocks contain a number of records and the records contain a number of fields. Blocks and records start with keywords.

A particular block keyword is unique within the file that contains that block. A block may contain multiple records that start with the same record keyword. Block and record keywords must always start at the first character position of a new line in the file. Leading white_space characters are not allowed.

Each record starts on a new line at the first character position, and terminates on the same line with the carriage return character CR (ASCII code 13). This is followed by the line-feed character LF (ASCII code 10).

Each record contains one or more fields, separated from each other and from the keyword by a non-empty sequence of the white space characters SPACE or TAB. In particular, a record does not contain CR or LF characters except for termination purposes. Line length is limited to 1024 characters, for readability purposes however, it is advised to keep the line length of a record, exclusive to the terminating CR or LF characters, below 80.

A block consists of a number of consecutive lines in the involved file. It starts on the line that contains its block keyword, and ends at the beginning of the first encountered line that contains another block keyword.

The order of the blocks within a file is free, as is the order of the records within a single block. The order of the fields within a single record however, is fixed. Empty blocks and empty records may be omitted; empty fields however, may only be omitted where allowed.

The structure of the system placement program is as follows:

First character position on a line

```
[BLOCK_KEYWORD1]            <CRLF>
RECORD_KEYWORD11            field111        field112        ...         <CRLF>
RECORD_KEYWORD12            field12         ...             <CRLF>
                            ...             ...             ...
                            ...             ...             ...
RECORD_KEYWORD1p            field1p1        ...             <CRLF>
<CRLF>
[BLOCK_KEYWORD2]            <CRLF>
RECORD_KEYWORD21            field211        field212        ...         <CRLF>
RECORD_KEYWORD22            field221        ...             <CRLF>
                            ...             ...             ...
                            ...             ...             ...
RECORD_KEYWORD2q            field2q1        ...             <CRLF>
<CRLF>
                            ...             ...             ...
                            ...             ...             ...
[BLOCK_KEYWORDn]            <CRLF>
RECORD_KEYWORDn1            fieldn11        fieldn12        ...         <CRLF>
RECORD_KEYWORDn2            fieldn21        ...             <CRLF>
                            ...             ...             ...
                            ...             ...             ...
RECORD_KEYWORDnr            fieldnr1        ...             <CRLF>
<CRLF>
```

7.5.1.1Matching values

Various records in an placement program refer to other records in the same file. For these records there are matching values for some of the fields that they have in common. The following rules apply:

- Referrals are made to a set of fields from a record.
- The combination of values that these fields have must be unique. This set of fields is called the primary key (arrowed) (Figure 103).
- The corresponding set of fields of a referring record is called the foreign key (arrowed) (Figure 104).
- For one particular primary key: all foreign keys must exactly match the primary key.

This method of record referencing has been introduced to keep dedicated processing information in one location. This prevents multiplication of information within a placement program.

```
[CONFIGURATION]
;              fa_nb
FA               FA1
FA               FA2
;            head_nb
HEAD             HD1   DPH
HEAD             HD2   DPH
HEAD             HD3   FPPH1
HEAD             HD4   FPPH1
;              ca_nb   typ
CA               CA1   LRG
CA               CA2   LRG
;                 nb   typ
FEEDER_SECTION FB1   A_SERIES_FDR_TROLLEY
FEEDER_SECTION FB2   A_SERIES_FDR_TROLLEY
FEEDER_SECTION FB3   A_SERIES_FDR_TROLLEY
FEEDER_SECTION FB4   A_SERIES_TRAY_TROLLEY
;             teu_nb teu_type
TEU              TE2
```

Figure 103 Primary key example

```
[SETUP]
;              tlb_id     hd
TOOLBIT          S3     TE2-FPP
TOOLBIT          O3I2   TE2-FPP
TOOLBIT          V3     TE2-CP
TOOLBIT          V3     TE2-CP
TOOLBIT          V4     TE2-CP
TOOLBIT          V5     TE2-CP
;fs_nb  fdr  slt  feeder_id  component_id    pick x          y          z  phi
bar_nb  fdr_nb  slt_nb
FEEDER           FB1   10     1   ITF2_16       11  -112.54-65.500  -0.250  0
FEEDER           FB1   15     1   ITF2_32       22  -57.350  -65.500  -0.250  0
FEEDER           FB2    5     1   ITF2_24       33  -8.750  -65.500  -0.250  0
FEEDER           FB2   10     1   ITF2_16       44  31.750  -65.500  -0.250  0
FEEDER           FB3   10     1   ITF2_44       55  64.150  -65.500  -0.250  0
FEEDER           FB4    2     1   BQ24X24       66  104.650  -65.500  -0.250  0
```

Figure 104 Foreign key example

7.5.1.2 General rules

The following general rules apply to all placement programs:

- Comment and blank lines.
  - Blank lines are allowed anywhere in the placement program.
  - A comment line is a record that is allowed anywhere in the placement program.
  - Each comment record must start on the first position of a new line with the keyword 'COMMENT' or with a semicolon ';'.
  - Example:
    COMMENT This is a comment
    ; This is a comment
- Blocks
  - Each block must start on the first position of a new line with a block name between '['and ']'.
  - Block names are unique and must be exactly according to specification. The system will not recognize wrong block names, (for example: non-capitalized block names are wrong).
  - The order in which blocks can occur is free.
  - Empty blocks may be omitted.
  - example:
    [CONFIGURATION]
- Records
  - Records start with a keyword, keywords are specified names that must be exactly according to specification. The system will not recognize wrong keywords, (for example: non-capitalized keywords are wrong).
  - A record keyword has a unique meaning within a block, but the same keyword can be used more than once in a block, each time with different parameters.

For example, to tell the system the positions where to place a component, a record named COMPONENT is available within the block [PCB]. For each component that the system must place, there is a corresponding COMPONENT record in the block [PCB].

- The order of records within a block is free.
- The record keyword and its parameters must be separated by at least one space character.
- Example:
  COMPONENT 1 C12 4822_456_78900 123.55 19.98 90.0 1 2 3

7.6 Placement program

7.6.1 Processing

When a system processes an placement program, it first verifies the specified set-up and configuration against its current set-up and configuration. If these do not match, then the system will not accept the placement program. When this happens either the placement program should be modified or the operator has to take appropriate actions to establish a match. If the specified set-up and configuration are matching, the system can run the placement program. Running a placement program means executing the specified actions, in general one by one, in exactly

the same order as they are listed in the corresponding block of the placement program file.

An action is a high level operation. An action implies moving the slide to a specified position and performing specified operation(s) at that position, (for example pick up a component or read the image of a fiducial mark). A record that specifies an action refers to other records in the placement program via foreign keys. These referred records either contain all the processing parameters which are needed to perform the indicated action or they will refer again to other records via foreign keys.

A general rule is that actions are performed one by one. There are a few exceptions to this rule. If two consecutive actions specify similar operations for the left and the right placement head of the X-slide, then these two operations may (partly) be executed in parallel. For example, two pick actions (simultaneous pick), two component alignment actions (simultaneous CA), or two coplanarity check actions (two consecutive CO measurements, saving some lift movements and some X-slide travelling time).

7.6.2 Placement program, structure

A placement program may contain any of the blocks shown in the screens 111 through 117. A placement program however must be in accordance with:

- A placement program must contain at least a [GENERAL] block, a [PCB] block and a [SETUP] block.
- All blocks occur once in a placement program.

See 7.14.Placement programs, examples

7.6.3 Placement program, type definitions

To enable the system to interpret placement programs correctly, it is necessary for the writer of the placement program (either a person or a PPS) to obey a number of syntactical rules. Figure 105 explains the notations that are used to write the syntax description of the placement program. Figure 106 gives the syntax description which enables the user to check if a placement program complies with that description.

NOTATION	MUST BE INTERPRETED AS FOLLOWS
N:{item}:M	A sequence containing minimum N and maximum M items. When N is omitted zero items are allowed and when M is omitted, an unlimited number of items is allowed
[item]	Zero or one instance of the item
<a> 1 **<b>**	a or b
<a>...**<b>**	Including <a> up to <b> (in ASC11 order)
quotes(")	Specify literal characters

Figure 105 Syntax notations

SYMBOL	REPLACES
real	[sign] integer ['.' integer]
sign	'-'
integer	1:{digit}
digit	'0' | '1' | '2' | '3' | '4' | '5' | '6' | '7' | '8' | '9'

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SYMBOL	REPLACES
any_string	{char | digit | punctuation | white_space}
string	1:{char | digit | punctuation}
For each positive integer N, a string of maximum strength N is defined by: string (N)	1:{char | digit | punctuation}:N
dos_name	1:{upper_case | digit | dos_punctuation}:8
upper_case	'A' |....| 'Z'
char	'a' |.....| 'z' | 'A' |....| 'Z'
punctuation	dos_punctuation | ',' | '.' | '/' | ';' | '[' | ']' | '\' | '=' |'" | '@' | '*' | '+' | '|' | '?' | ':' | '<' |'>' | '&' | '(' | ')' |'{' | '}' |
dos_punctuation	'-' | '_' | '$' | '^' |'!' | '#'
white_space	SPACE|TAB

Figure 106 Syntactical rules

7.7 Placement program, general blocks

The general block contains global information about the placement program, such as its creator, the machine and the production line it is part of. Comments ([ ] = comments) can be added to clarify the purpose of the placement program.

- SYNTAX
- CREATOR
- FILE_ID
- LINE_ID
- MACH_ID
- MACH_ADDR
- ISSUEDATE
- CYCLE_TIME
- FAMILY

Rules on 'General' block

- This block must contain at least the SYNTAX record.
- All records in the [GENERAL] block must have different record keywords.

The following sub-sections describe the records that can occur in a [GENERAL] block in detail.

7.7.1 Placement program, syntax

This record is a reference to the version number of the specification of the syntax of the placement program as used by PPS or any other creator. The general block must at least specify the version_nb.

SYNTAX version_nb

Example: SYNTAX 6

- version_nb
  - integer
  - 1...32767

- Indicates the syntax according to which the placement program is created, this document describes syntax version 6

7.7.2 Placement program, creator

This record can be used to identify the creator of the placement program.

CREATOR creator

Example: CREATOR Aristotoles

■ creator
- any_string
- Name of the creator of the placement program

7.7.3 Placement program, file_id

When the placement program has been created with PPS this record will always display its file name. However, it is allowed to change the data in this field and it is not obligatory to match the file name of the placement program.

FILE_ID file_id

Example: FILE_ID aprod_1

■ dos_base_name (."extension)
- dos_name
- The first part of a file name according to the 8.3 name convention of the DOS file system

NOTE: Make sure that this field matches the actual base name of the placement program. For PPS users: If PPS has generated the placement program and this record has not been changed, then the extension that is added to the file_id will be according to the format.XXY where:

XX = the family member identification, if XX = 00 then the placement program is not related to a family.

Y = the identification number of the system in the flow-line.

7.7.4 Placement program, line_id

Record to identify the production line for which this placement program is intended.

LINE_ID line_id

Example: LINE_ID L_AQ_1

■ line_id
- string(20)
- Identifies the line by name

7.7.5 Placement program, mach_id

Record to identify by name the system for which the placement program is intended. This system must be present in the production line that is identified by line_id.

MACH_ID mach_id

Example: MACH_ID Aristo_1

- mach_id
  - string(20)
  - Identifies the system by name

7.7.6 Placement program, mach_addr

Record to identify by number the system for which this placement program is intended.

MACH_ADDR mach_addr

Example: MACH_ADDR 3

- mach_addr
  - integer
  - lowest value 1, highest value 9
  - Identifies the system by number
  - This number matches the position

7.7.7 Placement program, issue date

Record to display the date the placement program is created.

ISSUEDATE year - month - day

Example: ISSUEDATE 1995-2-15

- year
  - integer
  - 1950...2050
  - Year figure in a date. The year must be written using 4 digits
- month
  - integer
  - 1...12
  - Month figure in a date
- day
  - integer
  - 1...31
  - Day figure in a date (depends on the particular month)

7.7.8 Placement program, cycle_time

CYCLE_TIME time

Example: CYCLE_TIME 132.6

- time
  - real
  - Expected average product cycle time in seconds

7.7.9 Placement program, family Board

FAMILY family_id

Example: FAMILY our_superboards

- family_id

- string(20)
- Identifies the family of boards for which the set-up, specified in the [SETUP] block, is valid
- Last pick-up position of tray is stored for use in production of next family board.

7.8 Placement program, PCB Block

The PCB block describes the board layout, the dimensions, fiducial marks, badmarks and components on the board.

- Board layout and sizes
  - The board size data is used to convert all component coordinates from the board coordinate system to the coordinate system.
- Fiducials, badmarks and components
  - positions
  - related badmarks
  - related fiducial correction matrices
- The following records can exist in the PCB block:
  - PROD_ID
  - BOARD_DIM
  - BOARD_ORIGIN
  - SIDE
  - BOARD_HEIGHT
  - BADMARK
  - FIDUCIAL
  - ALIGNMENT
  - COMPONENT

Comment records are allowed between these records.

7.8.1 Product Identification

This record can be used to identify the product to be processed.

PROD_ID product_id

Example: PROD_ID PXA112B

- product_id
  - string(20)
  - Identifies the product name which is an individual member of a family product. When the family_id is specified in the general block, the product_id identifies an indivimember of a family product
  - Occurs exactly once in the [PCB] block

7.8.2 Board Dimensions

This record is used to specify the board size (outer, rectangular matching coordinates).

BOARD_DIM pcb_length pcb_width pcb_thickness

Example: BOARD_DIM 123.0 60.0 1.75

- pcb_length (Figure 107)
  - real (mm)
  - Board length (in X-direction of board coordinate system)
  - Minimum value: **50 mm**
  - Maximum value depends on board orientation in transport
- pcb_width (Figure 107)
  - real (mm)
  - Board width (in Y-direction of board coordinate system)
  - Minimum value: **50 mm**
  - Maximum value depends on board orientation in transport
- pcb_thickness
  - real (mm)
  - 0.4 to 7.0 mm

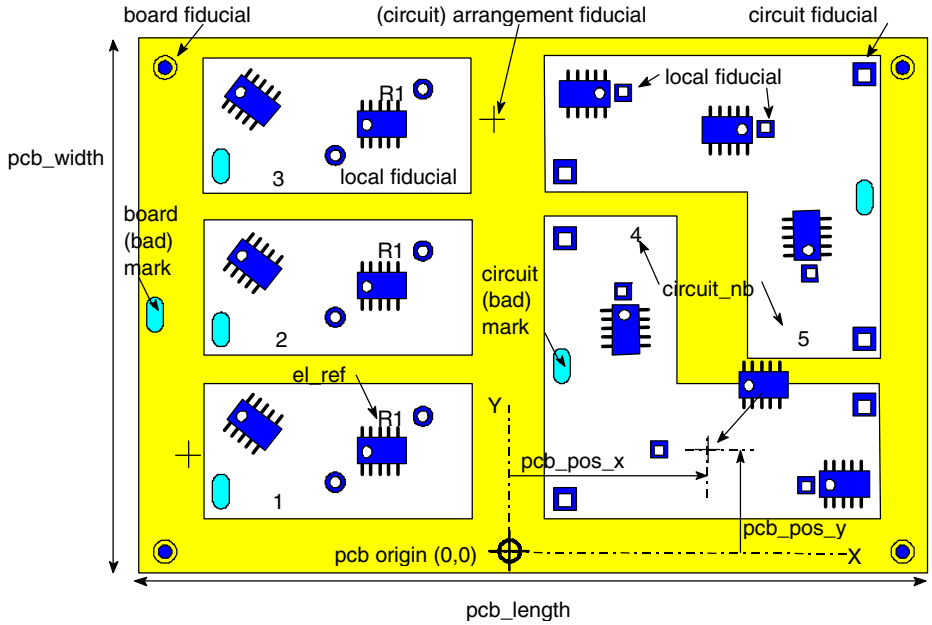

Figure 107 PCB Objects

For maximum board dimensions, see 2.4.Board specifications

Though the board to be processed may have any shape (as long it can be handled by the system), this record specifies the dimensions of the smallest rectangle that encompasses the entire board.

7.8.3 Board origin

The board origin is the reference for all placement co-ordinates on the board. By default the south-east corner oF the board (as positioned in the machine) is the board origin. In this case X=0, Y=0 and RZ (Phi)=0.

- The X and Y values are offset values for the board origin.
  Example: X=20, Y=10. In this case the board origin is located 20 mm to the left and 10 mm above the south-east corner of the board.
- The RZ (Phi) value represents the rotation of the complete board, including all placement coordinates. By default RZ (Phi)=0.
  Example: Phi=90. in this case the complete board is rotated 90 degrees counter clockwise.

Examples:

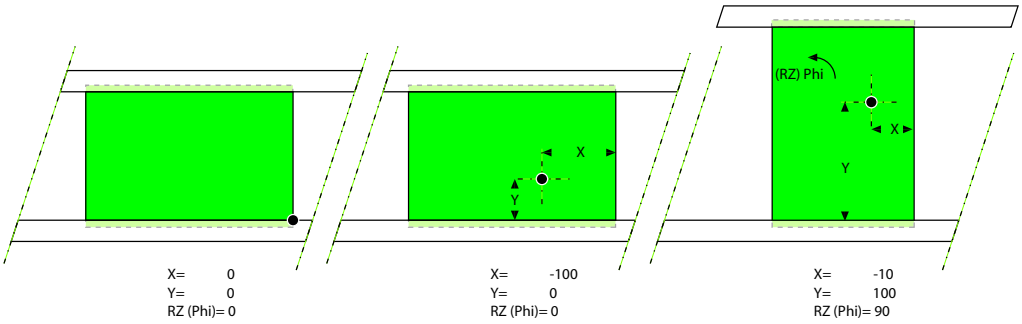

Figure 108 Board origin

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This specifies the origin of the board co-ordinate system with respect to the machine co-ordinate system.

BOARD_ORIGIN pcb_origin_x pcb_origin_y pcb_origin_phi

Example: BOARD_ORIGIN 100.0 10.0 0

- pcb_origin_x, pcb_origin_y (Figure 109)
  - real (mm)
  - This is a vector that originates in the south-east corner of the board in assembly position in the system
- pcb_origin_phi
  - integer (degrees)
  - 0, 90, 180, 270
  - The orientation of the board coordinate system with respect to the machine coordinate system, in assembly position in the system

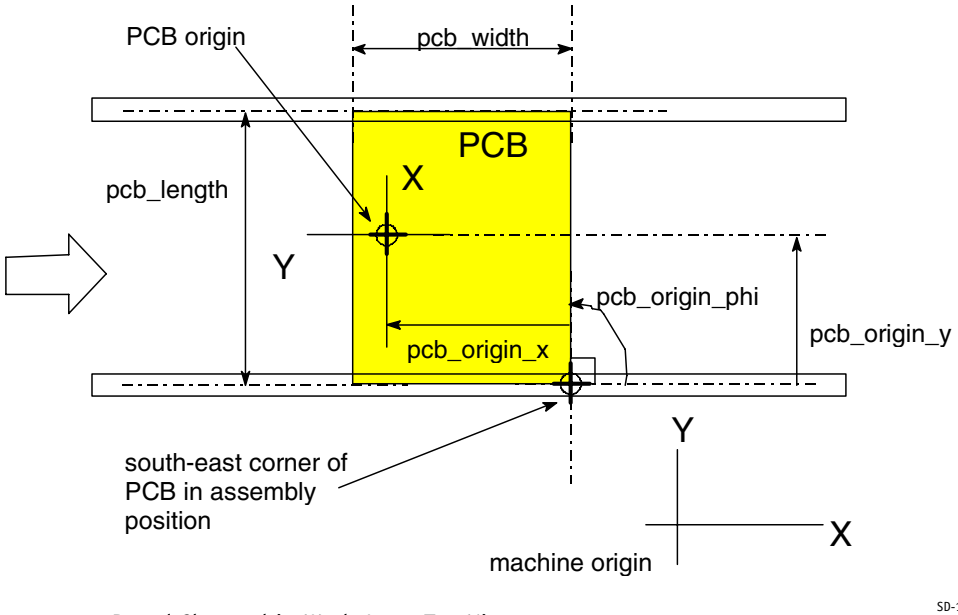


Figure 109 Board Clamped in Work Area, Top View

7.8.4 Board side

This record specifies the side of the board that must be assembled.

SIDE pcb_side

Example: SIDE TOP

- pcb_side (Figure 110)
  - TOP / BOTTOM
  - Top = Top side, Bottom = Bottom side
  - If this record is omitted then default T is selected

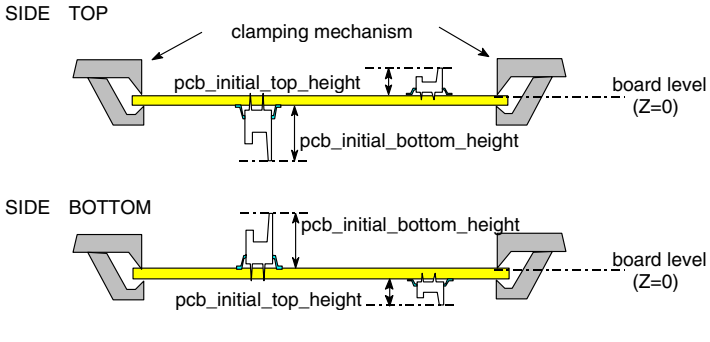


Figure 110 Board Side and Height

7.8.5 Product height

This record provides the system with information about components or other objects that are already present on the board before it enters this particular system. This data is used to determine the minimum height of the nozzle tip (including a particular component) to prevent collision with these objects during servo movements.

BOARD_HEIGHT pcb_initial_top_height pcb_initial_bottom_height

Example: BOARD_HEIGHT 1.25 0.5

In this record the top side of a board is regarded as the side where the system must place components.

- pcb_initial_top_height, pcb_initial_bottom_height (Figure 110)
  - real
  - Minimum values: 0.0 mm
  - Maximum values; assembly side: 25 mm, other side: 45 mm
  - Maximum height of earlier placed components/objects at the top and bottom sides of the board
  - Values are absolute (positive)
  - If this record is omitted the default 0.0 mm is assumed for both values

7.8.6 Badmark

This record specifies the board position and processing characteristics of a single badmark. Several of these records can be present in this block, for each badmark one record. A parameter is available to give a relationship to another (master) badmark. The necessity for detection of the defined badmark depends on detection of the master badmark. When a master badmark is marked, it will be detected by the camera and all circuits that belong to this master badmark have to be inspected to find out which are good or bad circuits. Alternately, if there is no master badmark, then the system can accept the entire board and all components can be placed.

When no master badmark is defined on the board (Figure 107) and only circuit badmarks are defined then the system has to carry out badmark inspections for all circuit badmarks.

BADMARK bad_mark_nb bad_mark_art pcb_pos_x pcb_pos_y alignment_nb [bad_mark_ref]

Example: BADMARK 3 circuit2 75.0 45.0 1 1

- bad_mark_nb
  - integer
  - 1...32767
  - placement program badmark reference number
  - This number may occur only once on this place in [PCB] block
- bad_mark_art
  - dos_base_name
  - Identifies the badmark, this is a vision file. This vision file contains all detailed information about the characteristics of the badmark artwork
- pcb_pos_x and pcb_pos_y
  - real (mm)
  - X and Y positions of the badmark in board coordinate system
- alignment_nb
  - integer
  - 0...32767
  - If non-zero, this is a reference to a fiducial alignment correction matrix. The coordinates from this matrix will be used to correct the position of the badmark. If the value of this parameter is 0 then no alignment correction is executed
- bad_mark_ref
  - integer
  - 1...32767
  - Specifies that the current badmark is not to be searched for if the badmark referred to by bad_mark_ref is present on the board

7.8.7 Fiducial

This specifies the board position and processing characteristics of a single fiducial mark. The system requires a group of fiducials to calculate estimated artwork offsets on the surface of the board (Figure 107). Several fiducial records can be specified in the board block, with each fiducial having its own record. A parameter is available to give a relationship to a badmark.

FIDUCIAL fiducial_nb fiducial_art pcb_pos_x pcb_pos_y alignment_nb [bad_mark_nb]

Example: FIDUCIAL 2 fidu2 15.0 12.0 1 3

- fiducial_nb
  - integer
  - 1...32767
  - placement program fiducial reference number
- fiducial_art
  - dos_base_name
  - Name of a file in the system, containing all necessary processing data for this fiducial
- pcb_pos_x and pcb_pos_y
  - real
  - X and Y positions of the fiducial, in the board coordinate system
- alignment_nb
  - integer

- 0...32767
- Reference to a fiducial alignment correction matrix. If the value of this parameter is 0 then no alignment correction is executed
- Zero:global alignment
  Non-zero:local alignment

■ bad_mark_nb
- integer
- 1...32767
- placement program badmark reference number. If this badmark is marked the system will not attempt to detect this fiducial

7.8.8 Alignment

The system uses correction matrices that contain coordinates of measured fiducials. The correction method (correct for offset, rotation or stretch) is determined by the attributes assigned to the fiducial (N=normal, O=offset, R=rotation, S=spare). Spare fiducials are used when the regular fiducials are not recognized.

Two kinds of alignment matrices can be distinguished: global and local alignment. A global matrix can be used to correct offsets of an entire board. After all fiducial markers belonging to the global matrix have been read, the system can calculate where the fiducial markers of all local fiducial matrices can be found. The local matrices will provide more accurate information on smaller areas of the board, enabling the placements of components that require a high level of precision.

It is not permissible to mix fiducials of all attribute types. The following types are allowed together. Select one of the following sets:

■ Global alignment
- N N (Normal fiducial followed by a Normal fiducial)
- N N S
- N N N
- N N N S
- O R

■ Local alignment
- O
- O O

ALIGNMENT alignment_nb fiducial_nb fiducial_attr

Example: ALIGNMENT 2 3 N 4 N 7 S

■ alignment_nb
- integer
- 1...32767
- Reference to this fiducial alignment correction matrix

■ fiducial_nb
- integer
- 1...32767
- placement program fiducial reference number
- Numbers must differ from each other within the same ALIGNMENT definition
- Min. 1 and max. 4 fiducial numbers are allowed in one ALIGNMENT definition
- A particular fiducial_nb may occur at the most once in one pcb_alignment_rec

- Fiducials referred to by the fiducial_nb with corresponding fiducial_attr equal:
  - O: Applied for offset correction only
  - R: Applied for rotation correction only
  - N or S: Applied for offset, rotation and stretch correction

■ fiducial_attr
- N | O | R | S
- Indicates the application of the fiducial in the transformation algorithm
- O: Offset correction
- R: Rotation correction
- N: Normal correction
- S: Spare
- fiducial_nb and fiducial_attr are grouped in pairs

7.8.9 Component

This record contains the location on the board where a component has to be placed and defines which correction matrix has to be used. A parameter is available to make the placement of the component dependent on the absence of a badmark.

COMPONENT circuit_nb item_code component_id pcb_pos_x

pcb_pos_y phi_pcb g_alignment_nb

l_alignment_nb [bad_mark_nb]

Example: COMPONENT 3 R83 12NC 25.8 130.2 45.0 2 1 3

■ circuit_nb
- integer
- 1...300
- Identifies the circuit on a board

■ item_code
- string(20)
- Electrical reference of the component. Together with circuit_nb this uniquely identifies the object on the board

■ component_id
- string(20)
- Denotes component stock code (component part number)

■ pcb_pos_x (Figure 107)
- real (mm)
- X position in board coordinate system

■ pcb_pos_y (Figure 107)
- real (mm)
- Y position in board coordinate system

■ phi_pcb
- real (degrees)
- 0...360
- Orientation of the component in board coordinate system with respect to the component origin

■ g_alignment_nb
- integer

- Not zero
- Reference to the global fiducial alignment correction matrix. This matrix corrects for: offset, rotation and possibly stretch

■ l_alignment_nb
- integer
- 0...32767
- Reference to a local fiducial alignment correction matrix. This second correction matrix replaces the offset correction from the global alignment matrix. If the value of this parameter is 0 then no local alignment correction is executed

■ bad_mark_nb
- integer
- 1...32767
- placement program badmark reference number. If this badmark is detected then the component should not be placed

7.9 Component-tooling block

This block defines how components are supplied, how to be picked, carried and moved by what toolbit, how to be aligned and mounted.

The following records can exist in the COMPONENT-TOOLING block:

■ COMPONENT
■ NOZZLE
■ GRIPPER
■ TAPE
■ TRAY

7.9.1 Component

A component record contains one component for the component_id and the relevant processing characteristics. The component_id is the reference key to information available in other records.

COMPONENT component_id ca_ref_id

Example: COMPONENT qfp112

■ component_id
- string (20)
- Denotes component stock code

■ ca_ref_id
- dos_base_name
- Reference to system vision files for component alignment

7.9.2 Nozzle

The placement program should contain this record for each component that has to be picked with a nozzle. It defines the component-nozzle combination with the specific processing parameters.

NOZZLE component_id toolbit_id nozzle_tip_nb

handling_class vacuum_check_level phi_tlb

Example: NOZZLE 0?I2 INNER 2 50 0

- component_id
  - string (20)
  - Denotes component stock code
- toolbit_id
  - dos_base_name
  - select one of the following:

O?Ix In this case the outer nozzle tip is not used, the inner tip (x) must be specified (integer value: 1...9)

OxI? In this case the inner nozzle tip is not used, the outer tip (x) must be specified (integer value: 1...4)

NOTE: This is the only record where the question mark has the function of a wild-card for this field.

  - Reference to file, which contains all needed processing data for the specific toolbit
- nozzle_tip_nb
  - INNER | OUTER
  - Identifies specific nozzle tip

In case the toolbit is a single nozzle or toolbit for a placement head DV use 'OUTER'.

- handling_class
  - 1 | 2 | 3 | 4
  - Indicates processing limits. 1 is the fastest speed class
- vacuum_check_level
  - integer
  - 0...100 (%)
  - The vacuum system air flow sensor value, under the condition that a nozzle is mounted on the respective head. When this value has not been exceeded then the nozzle carries a component

NOTE: Using a value of 100% skips the vacuum check.

- phi_tlb (Figure 111)
  - integer (degrees)
  - 0, 90, 180, 270
  - The rotation needed by the nozzle to pick a component with respect to the defined zero orientations for nozzle and component

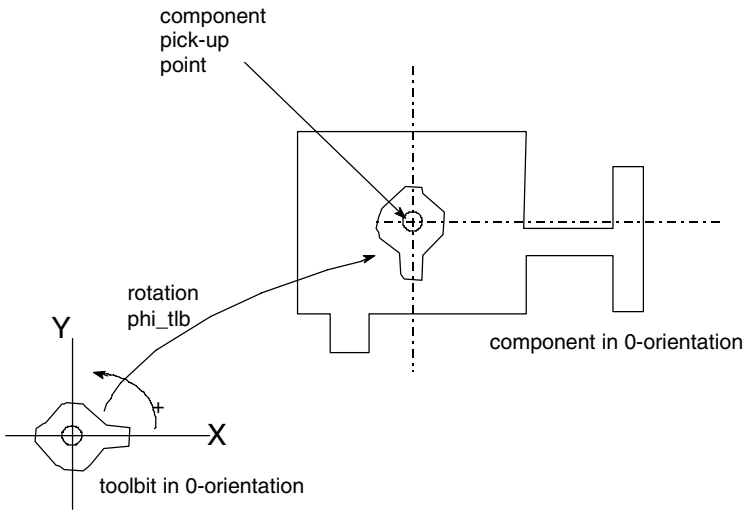


Figure 111 Component Pick-up Point

7.9.3 Gripper

The placement program should contain this record for each component that has to be picked with a gripper, it defines the component-gripper combination with the specific processing parameters.

GRIPPER component_id toolbit_id handling_classphi_tlb

Example: GRIPPER g2 handling_class 90

- component_id
  - string(20)
  - Denotes component stock code
- toolbit_id
  - dos_name
  - Reference to file, which contains all needed processing data for the specific toolbit
- handling_class
  - 1 | 2 | 3 | 4
  - Actual set of processing limits if the toolbit is a nozzle or a gripper.
- phi_tlb
  - integer (degrees)
  - 0, 90, 180, 270
  - The rotation needed by the gripper to pick a component with respect to the defined zero orientations for gripper and component

7.9.4 Tape

This record describes the process data regarding the feeding of components.

TAPE component_id feeder_id phi_fdr [empty_warning_level too_many_cmps_used number_of_cmps]

Example: TAPE 8mm 0 10 2 3000

- component_id
  - string(20)
  - Denotes component stock code
- feeder_id
  - dos_base_name
  - Identifies the feeder
- phi_fdr
  - integer (degrees)
  - 0, 90, 180, 270
  - The orientation of the component with respect to the tape (tape in feeder)
- empty_warning_level
  - integer
  - 1...32767
  - When this number of components remains in the feeder, the user is informed
- too_many_cmps_used
  - integer
  - 1...32767
  - When this number of components is picked from a theoretically empty tape, then the user is notified
- number_of_cmps
  - integer
  - 1...32767
  - Number of available components expected in a tape feeder

7.9.5 Tray

This record describes the layout and process data of a tray.

TRAY component_id feeder_id phi_fdr tray_x_count tray_y_count tray_x_pitch tray_y_pitch [tray_speed_class] [empty_warning_level too_many_cmps_used]

Example: TRAY T5*4 0 5 4 100.0 100.0 5 1

- component_id
  - string(20)
  - Denotes component stock code
- feeder_id
  - dos_base_name
  - Identifies the feeder
- phi_fdr
  - integer (degrees)
  - 0, 90, 180, 270
  - The orientation of the component with respect to the feeder
- tray_x_count
  - integer
  - 1...255
  - The number of components in x direction in a tray
- tray_y_count
  - integer
  - 1...255

- The number of components in y direction in a tray

NOTE: Tray_x_count * tray_y_count may not exceed 32767.

- tray_x_pitch, tray_y_pitch
  - real (mm)
  - 0...1000
  - The x and y distance between pick-up position of adjacent components in a tray
- tray_speed_class
  - *LOW* | *MEDIUM* | *HIGH*
  - Specifies the speed by which the tray is exchanged from store position to pick-up position and visa versa.
- empty_warning_level
  - integer
  - 1...32767
  - When this number of components remains in the feeder, the user is notified
- too_many_cmps_used
  - integer
  - 1...32767
  - Normally tray_x_count * tray_y_count. When this number of components has been picked from the tray the operator is warned that the tray has become empty.

7.10 Configuration block

In the configuration block, the actual system configuration is defined. The following records can be present in the CONFIGURATION block:

- BA
- CA
- HEAD
- FEEDER_SECTION
- TEU (toolbit exchange unit)
- FLUX APPLICATOR

7.10.1 BA (board alignment)

NOTE: Board alignment (BA) in a placement program is called 'FA'.

Record to indicate the presence of an BA camera. When this record is omitted there is no BA camera (or it is not used) (Figure 112).

; fa_nb

Example: FA FA1

- fa_nb

- FA1 | FA2
- Identifies the BA camera, BA1 is on the front side of the X-slide

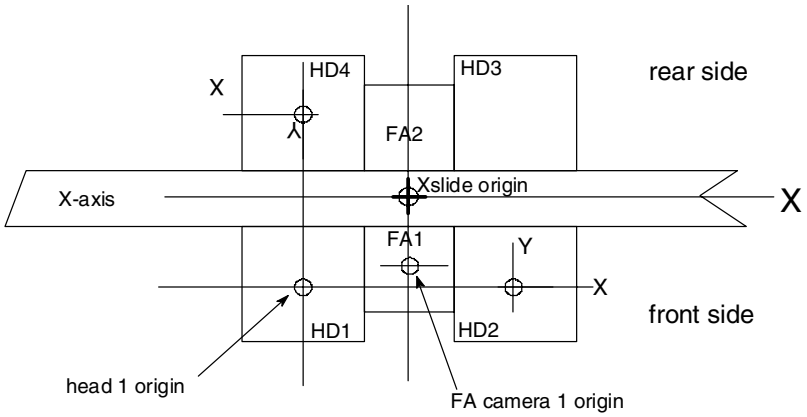


Figure 112 Position of BA Camera and Heads

7.10.2 CA

Record to specify the presence and location of a CV camera (Figure 113).

; ca_nb typ

Example: CA CA1 LRG

- ca_nb
  - CA1 | CA2 | CA3 | CA4
  - Indicates component CV camera position. CA1 is front tooling on left side. CA4 is rear tooling on left side
- ca_cam_type
  - LRG | SML
  - Reference to the field of view (FoV) of the camera (LRG indicates LFOV, SML indicates SFOV)

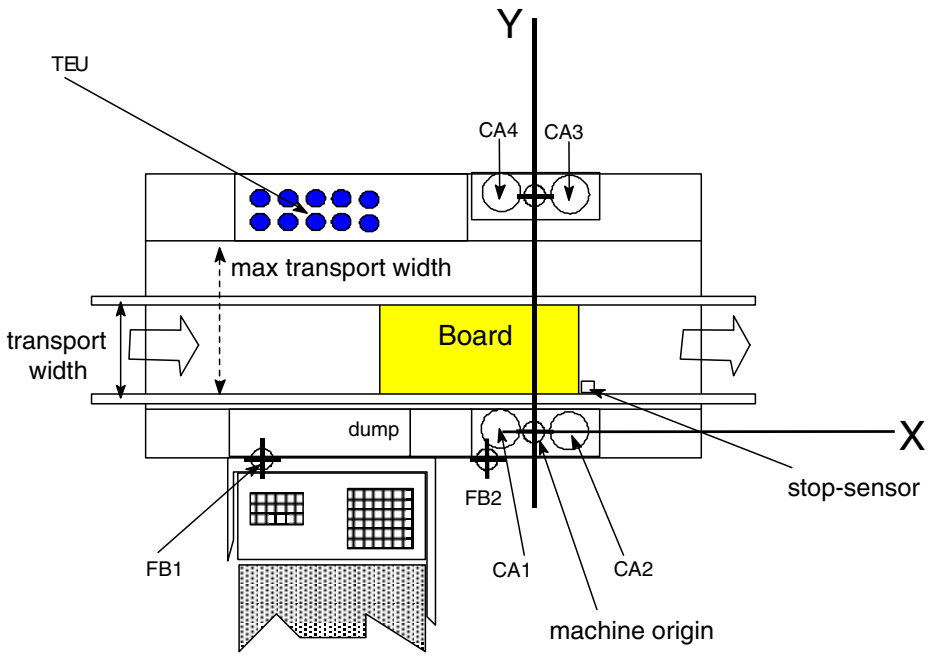


Figure 113 Possible Module Locations (top view)

7.10.3 Head

Record to specify presence and location of a placement head (Figure 112).

; head_nb typ

Example: HEAD HD2 IC1

- head_nb
  - HD1 | HD2 | HD3 | HD4
  - Indicates head position. HD1 is front head on left side, see (Figure 112).
- head_type
  - IC1 | IC2 | FPPH1 | FPPH2 | CPH
- head_suffix **Mandatory for placement head DV**
  - -1 | -2

- Head type indicator. -1 is the first induvidual placement head in the placement head DV.

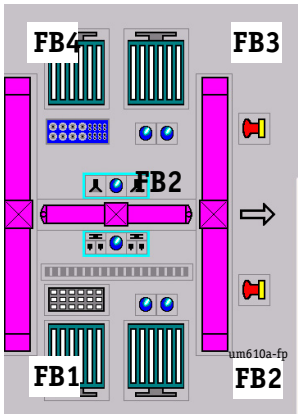
7.10.4 Feeder_section

Record to indicate the presence and position of a feeder section.Figure 114 gives a description of each type.

; nb typ

Example: FEEDER_SECTION FB2 TRAY_TROLLEY

- feeder_bar_nb
  - FB1 | FB2 | FB3 | FB4
  - Refers to a feeder section on the system. FB1 is front feeder section on left side.
- feeder_bar_type
  - FEEDER_BANK|FEEDER_TROLLEY| TRAY_PALLET|TRAY_TROLLEY
  - A type indication of the feeder - feeder_bar interface



FEEDER TYPE	DESCRIPTION
FEEDER_BANK	This is a fixed mounted storage facility suitable for both tape and stick feeders
FEEDER _TROLLEY	This is a trolley suitable for both tape and stick feeders
TRAY_PALLET	This is a single pallet or shelf fixed mounted and suitable for tray feeding
TRAY_TROLLEY	This is a trolley containing multiple shelves for tray feeding

Figure 114 Feeder values

7.10.5 Toolbit Exchange Unit

Record to indicate the presence of a toolbit exchange unit (not in software Version 2). ; teu_nb

Example: TEU TE2

- teu_nb
  - TE2
  - TE2 is on the rear
- teu_suffix
  - -CP | -FPP
  - -CP section of the toolbit exchange unit reserved for placement head DV toolbits.
    -FPP section of the toolbit exchange unit reserved for placement head HA toolbits.

7.10.6 Flux Applicator

Record to indicate the presence and position of a Flux Applicator.

; flux_nb

Example: FLUX FLUX1

- flux_nb
  - FLUX 1 | FLUX 2 | FLUX3 | FLUX4
  - Position of the flux applicator as seen from the front of the machine.

7.11 Setup Block

This block defines the set-up of feeders (positions) and toolbit (nozzles and grippers). The following records are allowed in the SETUP block:

- TOOLBIT
- FEEDER

7.11.1 Toolbit

This record specifies one toolbit. It must be specified for each toolbit that is used in pick and place actions.

TOOLBIT toolbit_id [head_nb]

Example: TOOLBIT 03I2 HD2

- toolbit_id
  - dos_name
  - Reference to the file which contains all needed processing data for the specific toolbit
- head_nb (OR 'teu.nb' when a toolbit exchange unit is present)
  - HD1 | HD2 (or TE2)
  - Indicates head position. HD1 is front head on left side.

If head_nb is specified, the identified toolbit must be mounted by the operator, on the head indicated by head_nb, prior to starting the system to run the current placement program for the first time. During 'rolling change over' it is the system controller itself that will take care of this; in general no operator intervention will be required.

If teu_nb is specified, the toolbit must be present in the toolbit exchange unit indicated by <teu_nb> prior to starting the system to run the current placement program.

7.11.2 Feeder

This record is used to describe how the feeders have to be put into the feeder trolleys (or on feeder bars). It can also be used to define how a tray with components should be placed in the tray trolleys (or on fixed tray pallets). The minimum that must be specified are the feeders and trays for the components that are referred to in pick actions in the same placement program, Figure 115 and Figure 116.

Optionally, alternate feeders can be defined. The parameters for alternate feeders can also be used to describe alternate trays (tray sections containing the same components). When a tray is empty and when an alternate tray has been specified

for it, the alternate tray will be selected and the pick-up actions will proceed without requiring operator intervention.

NOTE: Vacuum level check may not be set to 100.

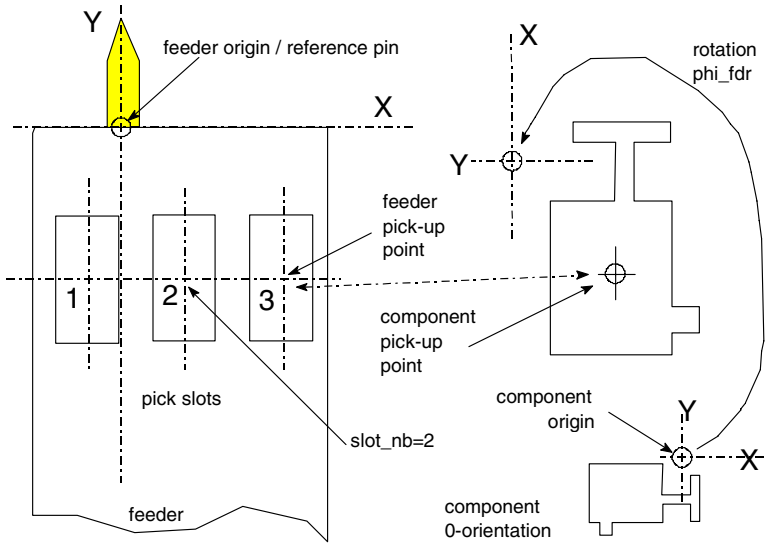


Figure 115 Feeder Pick Slots

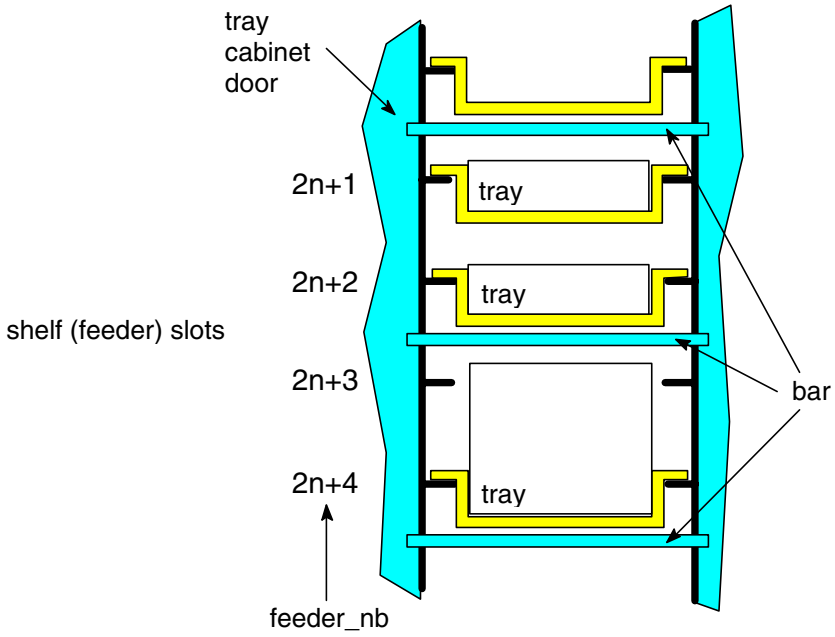


Figure 116 Tray Trolley Shelf Numbering

Phi-bar indicates the orientation of the tray w.r.t. the tray trolley or tray pallet. This orientation is needed to define the final pick coordinates for a tray.

This record has relations with several other records. Information about the feeder or tray trolley can be found in the block CONFIGURATION, record FEEDER_SECTION. Tape and tray layout can be found in the COMPONENT_TOOLING block, records TAPE and TRAY.

FEEDER feeder_bar_nb feeder_nb slot_nb feeder_id component_id pick_x pick_y pick_z phi_bar [alt_feeder_bar_nb alt_feeder_nb alt_slot_nb]

Example: FEEDER FB1 18 1 T4_2 75.0 12.0 0.0 0 FB1 20 1

- feeder_bar_nb
  - FB1 | FB2 | FB3 | FB4
  - Indicates feeder section. FB1 is front feeder section on left side. FB4 is the rear feeder section on left side
  - Optionally, alt_feeder_bar_nb: reference to alternate feeder section
- feeder_nb
  - integer
  - 1...25 (feeder section)
  - 1...50 (tray trolley)
  - Identifies the feeder position (feeder slot number). feeder_nb = 1 is the most left available feeder position on the feeder bar, or most upper tray in tray lift.
  - Optionally, alt_feeder_nb: reference to alternate feeder or tray
- slot_nb
  - integer
  - 1...4
  - Identifies the pick-up slot number on a (multiple) feeder, bulk feeder or tray pallet. This number increases from left to right
  - Optionally, alt_slot_nb: reference to alternate feeder
- feeder_id
  - dos_base_name
  - Identifies the feeder
- top_guide_pos
  - LEFT | RIGHT | N/A
- component_id
  - string(20)
  - Denotes component stock code
- pick_x, pick_y, pick_z
  - real (mm)
  - -2500...2500
  - The pick coordinates of a component with respect to the feeder bar origin. The tray origin is defined according the IEC standard
- phi_bar
  - integer (degrees)
  - 0, 90, 180, 270
  - The orientation of the feeder with respect to the feeder bar

The combination of feeder_bar_nb, feeder_nb and slot_nb uniquely identifies the current record among all records that are contained in the [SETUP] block.

feeder_bar_nb uniquely identifies a FEEDER_SECTION record within the CONFIGURATION block.

component_id and feeder_id together refer to a unique component-feeder relation in the [TOOLING] block (TAPE, Para. 7.9.4 and TRAY, Para. 7.9.5).

The possible values for feeder_nb are determined by the type of the involved feeder bank; 1 refers to the leftmost (tape feeder) position on a feeder bar or to the uppermost (tray) shelf in a tray lift. Sequential numbering is from left to right, or from top to bottom; the maximum number is **64**.

When feeders with multiple slots are used then slot_nb is a reference to the involved pick slot.

A tray shelf can have a maximum of two pick slots.

The positions on a feeder_bar or trolley have a pitch of 16 mm, this enables ITF_8 feeders to be assigned on adjacent positions. For other feeder assignments it is necessary to change the top guide.

The coordinates of the pick-up point of the involved component with respect to the feeder bar origin are given by pick_x, pick_y and pick_z; these are to be interpreted as the XY-coordinates of the component origin in the coordinate system of the involved feeder bar, and the Z-coordinate of the highest point of the component in pick position respectively.

phi_bar specifies the orientation of the (tape, stick or) tray with respect to the corresponding feeder in 0-orientation.

For each feeder (pick slot) it is possible to indicate a so-called alternate feeder (pick slot); if the current feeder (pick slot) is empty, then the system automatically switches to the alternate one. The latter is specified by the combination feeder_bar_nbr, feeder_nbr, slot_nbr.

7.12 Action block

List of machine actions in order to produce the requested boards.

NOTE: The action records contain redundant information. When a head picks a component, referred by circuit_id and el_ref, then the component processing data for all further actions (alignment and placing) is known and no further reference would be needed. However, for readability and traceability of the placement program actions, all actions refer again to the same component. When it is necessary to manually edit a placement program it is very important that consistency is maintained. Redundancy checks are not performed by the system.

The following records can exist in the ACTION block:

- ALIGN
- BADMARK
- FIDUCIAL
- MOUNT
- PICK
- TOOLBIT
- FLUX

7.12.1 Align

CA actions are specified as single actions, in other words for each component that has to be aligned one separate record is necessary.

ALIGN head_nb circuit_nb el_ref ca_nb

Example: ALIGN HD2 6 R83 CA3

- head_nb
  - HD1 | HD2 | HD3 | HD4
  - Indicates head position. HD1 is front head on left side.

- circuit_nb
  - integer
  - 1...300
  - Identifies the circuit on a board
- el_ref
  - string(20)
  - Electrical reference of the component. Together with circuit_nb this uniquely identifies the object on the board
- ca_nb
  - CA1 | CA2 | CA3 | CA4
  - Indicates camera position. CA1 is the front CV camera on left side. CA4 is the rear CV camera on left side

7.12.2 Badmark

This record commands the system to detect a badmark. BA camera is used to detect badmarks.

BADMARK fa_nb 1:{bad_mark_nb}

Example: BADMARK FA1 1 2

- fa_nb
  - FA1 | FA2
  - Identifies the BA camera
- bad_mark_nb
  - integer
  - 1...32767
  - Badmark reference number

Badmark detection implies the following system actions:

- Move the camera as specified in block [CONFIGURATION], record BA to the position as specified in block [PCB], record BADMARK.
- Detect badmark.

The [PCB] block, record BADMARK contains more information about when and how the badmarks must be applied.

7.12.3 Fiducial

This record commands the system to detect a fiducial. Fiducial detection implies the following system actions:

- Move the camera as specified in block CONFIGURATION, record BA to the position as specified in the PCB block, record FIDUCIAL.
- Detect the fiducial.

This record also may refer to spare fiducials.

FIDUCIAL fa_nb 1:{fiducial_nb}

Example: FIDUCIAL FA1 2 3 7

- fa_nb
  - FA1 | FA2
  - Identifies the BA camera
- fiducial_nb

- integer
- 1...32767
- placement program fiducial reference number

7.12.4 Mount

Record to command a mount action.

MOUNT head_nb circuit_nb el_ref

Example: MOUNT HD2 6 R83

- head_nb
  - HD1 | HD2 | HD3 | HD4
  - Indicates head position. HD1 is front head on left side.
- circuit_nb
  - integer
  - 1...300
  - Identifies the circuit on a board
- el_ref
  - string(20)
  - Electrical reference of the component. Together with circuit_nb this uniquely identifies the object on the board

7.12.5 Pick

PICK head_nb circuit_nb el_ref feeder_bar_nb feeder_nb slot_nb

Example: PICK HD2 6 R83 FB1 18 1

- head_nb
  - HD1 | HD2| HD3 | HD4
  - Indicates head position. HD1 is front head on left side.
- circuit_nb
  - integer
  - 1...300
  - Identifies the circuit on a board
- el_ref
  - string(20)
  - Electrical reference of the component. Together with circuit_nb this uniquely identifies the object on the board
- feeder_bar_nb
  - FB1 | FB2 | FB3 | FB4
  - Indicates feeder bar position. FB1 is the front feeder bar on the left side.
- feeder_nb
  - integer
  - 1...25 (feeder section)
  - 1...50 (tray trolley)
  - Identifies the physical feeder position (feeder hole number). feeder_nb = 1 is the most left available feeder position on the feeder section. In case of trays: feeder_nb = 1 is the most upper (tray) shelf in a tray lift
- slot_nb
  - integer

- 1..4
- Identifies the component pick-up slot number on a (multiple) feeder, bulk feeder or tray pallet. This number increases from left to right

7.12.6 Toolbit

Toolbit exchange record. Toolbit specific processing data is stored in the controller system.

Toolbit exchange implies:

- Move the specified head above the empty position in the exchange unit.
- Remove the toolbit.
- Move the head to the specified toolbit in the exchange unit.
- Take the toolbit from the exchange unit.

TOOLBIT [toolbit_id] head_nb

Example: TOOLBIT HD2 03I2

- head_nb
  - HD1 | HD2 | HD3 | HD4
  - Indicates head position. HD1 is the front head on the left side.
- toolbit_id
  - dos_name
  - Reference to file, which contains all needed processing data for the specific toolbit

7.12.7 Flux

FLUX head_nb circuit_nb el_ref flux_nb

Example: FLUX HD1 1 1 FLUX1

- head_nb
  - HD1 | HD2 | HD3 | HD4
  - Indicates head position. HD1 is front head on left side.
- circuit_nb
  - integer
  - 1...300
  - Identifies the circuit on a board
- el_ref
  - string(20)
  - Electrical reference of the component. Together with circuit_nb this uniquely identifies the object on the board
- flux_nb
  - FLUX1 | FLUX2 | FLUX3 | FLUX4
  - Indicates the position of the flux applicator

NOTE: It is NOT allowed to apply flux when handling a component with a gripper.

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7.13 Internal reference structure

The system of record referencing is widely used in the system placement program. Records that are referred to contain the information that is required to find all data that the system requires to execute a certain action. However, sometimes more data than needed is found. In such cases the system control software will ignore unnecessary data which might be required by other actions earlier in the same placement program. Figure 117 provides a general overview of the placement program reference structure. Figure 118 provides a general overview of the placement program record internal reference structure.

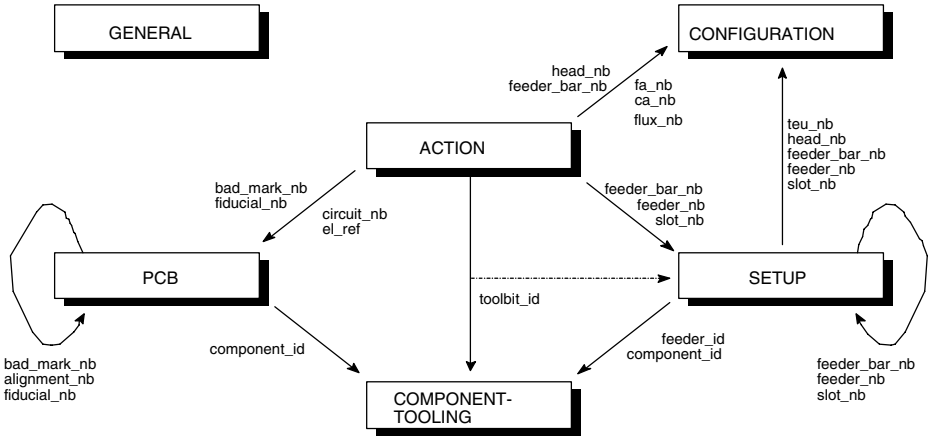

Figure 117 Placement program identification Data Block Internal Reference Structure

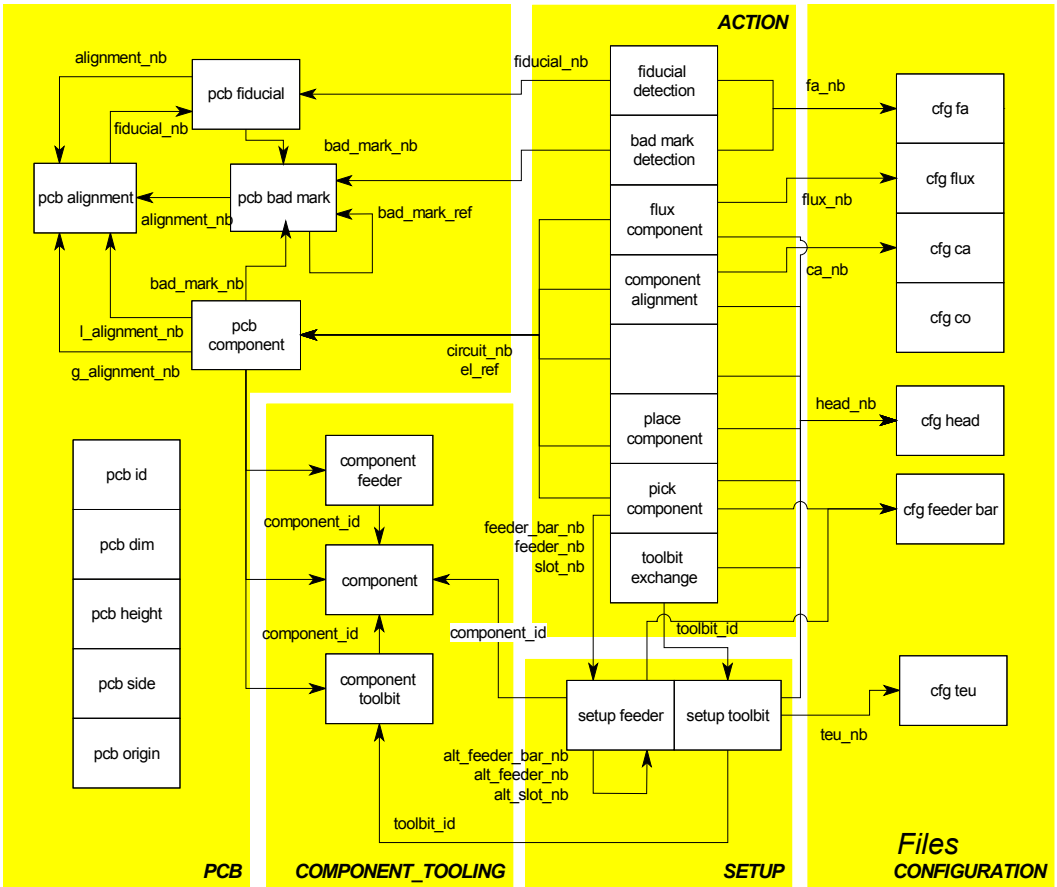

Figure 118 Placement program Record Internal Reference Structure

7.14 Placement programs, examples

7.14.1 Placement program, minimum

The minimum information which must be contained in the placement program is the information needed to transport a board through the system (without board alignment).

```
[GENERAL]
SYNTAX       6
[PCB]
PROD_ID      tst_wp_1
BOARD_DIM     200.000   400.000   1.000
BOARD_ORIGIN    0.000     0.000   0
```

7.14.2 Placement program with placement heads DV

Below an example with two placement heads DV and two placement heads HA.

```
[GENERAL]
SYNTAX       6
CREATOR      CIMBridge
FILE_ID      AX-201.asp
LINE_ID      L_AQ
MACH_ID      Samba
MACH_ADDR    1
ISSUEDATE    2004-06-30
CYCLE_TIME   7.642
FAMILY       FamilyName

[PCB]
PROD_ID      SAMBA_TOP
;              x       y       z
BOARD_DIM     202.000  212.000  2.050
; wrt. SE corner of PCB in the machine
;              x       y  phi
BOARD_ORIGIN  -202.000  0.000  0

SIDE        TOP

BOARD_HEIGHT  0.000 0.000

;            nb      art       x       y    al    ref
```

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```
;            nb      art       x       y     al    bm
FIDUCIAL      1  CIRCLE  14.500  38.600  0
FIDUCIAL      2  CIRCLE  187.500  88.600  0

;            nb   fid1 attr   fid2 attr   fid3 attr   fid4 attr
ALIGNMENT     1  1    N  2    N

;        circuit  item-code          component_id             x       y  phi   glob
loc    bm
COMPONENT     1  J1      11     169.250 75.500  270  1  0
COMPONENT     1  J2      22     46.250 75.500  270  1  0
COMPONENT     1  J3      33     87.250 75.500  270  1  0
COMPONENT     1  J4      44     128.250 75.500  270  1  0
COMPONENT     1  J5      55     66.090 54.600  90  1  0
COMPONENT     1  J6      66     148.090 54.600  90  1  0

[CONFIGURATION]
;         fa_nb
FA          FA1
FA          FA2
;       head_nb
HEAD        HD1  DPH
HEAD        HD2  DPH
HEAD        HD3   FPPH1
HEAD        HD4   FPPH1
;         ca_nb  typ
CA          CA1  LRG
CA          CA2  LRG
;           nb  typ
FEEDER_SECTION FB1  A_SERIES_FDR_TROLLEY
FEEDER_SECTION FB2  A_SERIES_FDR_TROLLEY
FEEDER_SECTION FB3  A_SERIES_FDR_TROLLEY
FEEDER_SECTION FB4  A_SERIES_TRAY_TROLLEY
;        teu_nb teu_type
TEU         TE2

[SETUP]
;          tlb_id    hd
TOOLBIT      S3   TE2-FPP
```

```
TOOLBIT      03I2  TE2-FPP
TOOLBIT      V3    TE2-CP
TOOLBIT      V3    TE2-CP
TOOLBIT      V4    TE2-CP
TOOLBIT      V5    TE2-CP

;fs_nb fdr slt feeder_id component_id   pick x      y      z phi bar_nb fdr_nb
slt_nb
FEEDER       FB1   10    1   ITF2_16     11  -112.54-65.500  -0.250  0
FEEDER       FB1   15    1   ITF2_32     22  -57.350  -65.500  -0.250  0
FEEDER       FB2    5    1  ITF2_24     33  -8.750  -65.500  -0.250  0
FEEDER       FB2   10    1   ITF2_16     44  31.750  -65.500  -0.250  0
FEEDER       FB3   10    1   ITF2_44     55  64.150  -65.500  -0.250  0
FEEDER       FB4    2    1  BQ24X24     66  104.650  -65.500  -0.250  0

[COMPONENT-TOOLING]
;          comp_id  ca_ref
COMPONENT     11SO16
COMPONENT     22PLCC44
COMPONENT     33CON20
COMPONENT     44SO16A
COMPONENT     55CON56
COMPONENT     66QFP208
; comp_id   tlb_id    tip_nb  class  check  phi
NOZZLE        11 V3    OUTER     3    80  0
NOZZLE        22 V5    OUTER     3    80  0
NOZZLE        33 V4    OUTER     4    70  0
NOZZLE        44 V3    OUTER     4    70  0
NOZZLE        55 S3    OUTER     2    70  0
NOZZLE        66 03I2   OUTER     2    70  0
;          comp_id           tlb_id    class  phi
;          comp_id           fdr_id    phi   empty_lev    cp_used    #cp
TAPE         11  ITF2_16  0
TAPE         22  ITF2_32  0
TAPE         33  ITF2_24  0
TAPE         44  ITF2_16  0
TAPE         55  ITF2_44  0
;comp_id   fdr_id    phi    cntx  cnty   pitch_x   pitch_y  class   empty_lev    cp_used
TRAY         66  BQ24X24  270   4     8     28       28      MEDIUM
```

```
[ACTION]
TOOLBIT     HD4  O2I3
TOOLBIT     HD3  S3
TOOLBIT     HD1-1  V3
TOOLBIT     HD1-2  V5
TOOLBIT     HD2-1  V4
TOOLBIT     HD2-2  V3
PICK       HD1-1  1  J1  FB1  10  1
PICK       HD1-2  1  J2  FB1  15  1
PICK       HD2-1  1  J3  FB2   5  1
PICK       HD2-2  1  J4  FB2  10  1
ALIGN       HD1-1  1  J1  CA1
ALIGN       HD1-2  1  J2  CA1
ALIGN       HD2-1  1  J3  CA2
ALIGN       HD2-2  1  J4  CA2
FIDUCIAL     FA1  1 2
MOUNT       HD1-1  1  J1
MOUNT       HD1-2  1  J2
MOUNT       HD2-1  1  J3
MOUNT       HD2-2  1  J4

PICK       HD3  1  J5  FB3  10  1
PICK       HD4  1  J6  FB4  2  1
ALIGN       HD3  1  J5  CA2
ALIGN       HD4  1  J6  CA1
MOUNT       HD3  1  J5
MOUNT       HD4  1  J6
```

7.14.3 Placement program with fiducial records

The following example is presented with four circuits on a board, with badmarks and with board, arrangement and local fiducials.

```
[GENERAL]
SYNTAX       6
CREATOR      Peter_Heuts
FILE_ID      afid1
LINE_ID      one_acm_1
MACH_ID      machine1
MACH_ADDR    1
```

```
ISSUEDATE     1999-1-3
CYCLE_TIME    0.200

[CONFIGURATION]
;          fa_nb
FA           FA1
;        head_nb   typ
HEAD         HD1   IC2
HEAD         HD2   IC1
;          ca_nb   typ
CA           CA1   LRG
CA           CA2   LRG
CA           CA4   LRG
CA           CA3   SML
;            nb        typ
FEEDER_SECTION  FB1   FEEDER_BAR
FEEDER_SECTION  FB2   TRAY_TROLLEY

[SETUP]
;       tlb_id     hd
TOOLBIT   tst_tb_2   HD1
TOOLBIT   tst_tb_4   HD2
;    fs_nb fdr slt feeder_id component_id   pick x       y       z  phi
FEEDER  FB1   1   1 ITF2_08 comp_1    11.100   11.100   0.000    0
FEEDER  FB2   1   2 ITF2_08comp_2  -45.000    5.000   1.000   90
[COMPONENT-TOOLING]
;         comp_id  ca_ref
COMPONENT    comp_1  tst_ca_1
COMPONENT    comp_2  tst_ca_1
;      comp_id     tlb_id  tip_nb class vac_l   phi
NOZZLE   comp_1   tst_tb_2   INNER     1    10   0.0
NOZZLE   comp_2   tst_tb_4   INNER     1    10   0.0
;      comp_id     fdr_id   phi cntx cnty  pitch_x  pitch_y
TRAY     comp_2 ITF2_0890    5    5   10.000   10.000
TAPE     comp_1 ITF2_08 0

[PCB]
PROD_ID     tst_wp_1
;              x       y       z
```

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```
BOARD_DIM     200.000  400.000    1.000
;               x       y      phi
BOARD_ORIGIN    0.000    0.000       0
; Initial        top    bottom
BOARD_HEIGHT    0.000    0.000
;         nb      art       x       y  align  bm
BADMARK     1    black   -1.000   25.000     0
BADMARK     2    black   -2.000   25.000     1   1
BADMARK     3    black   -3.000   25.000     1   1
BADMARK     4 triangle   -4.000   25.000     1   1
BADMARK     5 triangle   -5.000   25.000     1   1
;         nb      art       x       y  align  bm
FIDUCIAL    5 rectangl   -5.000   25.000     0
FIDUCIAL    6 rectangl   -6.000   25.000     0
FIDUCIAL    7   circle   -7.000   25.000    22
FIDUCIAL    8   circle   -8.000   25.000    22
FIDUCIAL    9   circle   -9.000   25.000     2   3
FIDUCIAL   10   circle  -10.000   25.000     2   3
FIDUCIAL   11   circle  -11.000   25.000     0
FIDUCIAL   12   circle  -12.000   25.000     0
FIDUCIAL   13   circle  -13.000   25.000     5   4
FIDUCIAL   14   circle  -14.000   25.000     5   4
FIDUCIAL   15   circle  -15.000   25.000     5   5
FIDUCIAL   16   circle  -16.000   25.000     5   5
;         nb fid1 attr fid2 attr fid3 attr fid4 attr
ALIGNMENT   2    5    N    6    N
ALIGNMENT   5   11    N   12    N
ALIGNMENT   3    7    0    8    0
ALIGNMENT   4    9    0   10    0
ALIGNMENT   6   13    0   14    0
ALIGNMENT   7   15    0   16    0
;    circuit item-code  comp_id        x      y     phi  glob   loc  bm
COMPONENT   1  c1_item1   comp_1     0.000  20.000   0.000    2    3   2
COMPONENT   2  c2_item1   comp_2   -40.000  20.000   2.000    2    4   3
COMPONENT   3  c3_item1   comp_1   -80.000  20.000   5.000    5    6   4
COMPONENT   4  c4_item1   comp_2  -120.000  20.000   7.000    5    7   5

[ACTION]
BADMARK             FA1              1
```

```
FIDUCIAL        FA1          5   6
BADMARK         FA1          2   3
PICK            HD1          1   c1_item1  FB1  1  1
PICK            HD2          2   c2_item1  FB2  1  2
ALIGN           HD1          1   c1_item1  CA1
ALIGN           HD2          2   c2_item1  CA2
FIDUCIAL        FA1          7   8
MOUNT           HD1          1   c1_item1
FIDUCIAL        FA1          9  10
MOUNT           HD2          2   c2_item1
FIDUCIAL        FA1          11  12
BADMARK         FA1          4
PICK            HD1          3   c3_item1  FB1  1  1
ALIGN           HD1          3   c3_item1  CA4
FIDUCIAL        FA1          13  14
MOUNT           HD1          3   c3_item1
BADMARK         FA1          5
PICK            HD2          4   c4_item1  FB2  1  1
ALIGN           HD2          4   c4_item1  CA1
FIDUCIAL        FA1          15  16
MOUNT           HD2          4   c4_item1
```

7.14.4 Placement program with fluxer records

The following example is an placement program with all tape components (without tsop32 and qf80 but with flipchip41 and ubga46).

```
[GENERAL]
SYNTAX       6
CREATOR      Richard_Nap
FILE_ID      flux_1
LINE_ID      one_acm_1
MACH_ID      machine1
MACH_ADDR    1
ISSUEDATE    1999-1-3
CYCLE_TIME   0.200

[CONFIGURATION]
;          fa_nb
FA           FA1
;        head_nb   typ
```

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```
HEAD        HD1  IC1
HEAD        HD2  IC1
;         ca_nb  typ
CA          CA1  SML
CA          CA2  SML
CA          CA4  SML
CA          CA3  SML
;       teu_nb
TEUTE2
;       flux_nb
FLUXFLUX1
FLUXFLUX2

;           nb        typ
FEEDER_SECTION  FB1  FEEDER_BAR
FEEDER_SECTION  FB2  TRAY_PALLET


[SETUP]
;      tlb_id     hd
TOOLBIT  tst_tb_1HD1
TOOLBIT  tst_tb_1HD2
TOOLBIT  tst_tb_2TE2
;    fs_nb fdr slt feeder_id component_id   pick x       y      z  phi
FEEDER  FB1   1   1 ITF2_08 comp_1   11.100   11.100   0.000    0
FEEDER  FB2   1   2 ITF2_08comp_215.000    5.000   1.000   90

[COMPONENT-TOOLING]
;       comp_id  ca_ref
COMPONENT   comp_1  tst_ca_1
COMPONENT   comp_2  tst_ca_1
;     comp_id     tlb_id  tip_nb class vac_l   phi
NOZZLE   comp_1   tst_tb_1INNER     1    10   0.0
NOZZLE   comp_2   tst_tb_1OUTER1    10   0.0
NOZZLE   comp_1tst_tb_2INNER     1    10   0.0
;     comp_id     fdr_id   phi cntx cnty  pitch_x  pitch_y
TRAY    comp_2 ITF2_0890    5    5   10.000   10.000
TAPE    comp_1 ITF2_08 0
[PCB]
PROD_ID     tst_wp_1
;             x      y      z
```

```
BOARD_DIM     200.000  400.000    1.000
;               x       y      phi
BOARD_ORIGIN    0.000    0.000       0
; Initial        top    bottom
BOARD_HEIGHT    0.000    0.000
;         nb      art       x       y  align
FIDUCIAL     1 triangle   -1.000   25.000      0
FIDUCIAL     2 triangle   -2.000   25.000      0
FIDUCIAL     3    cross   -3.000   25.000      0
FIDUCIAL     4    cross   -4.000   25.000      0
FIDUCIAL     5 rectangl   -5.000   25.000      1
FIDUCIAL     6 rectangl   -6.000   25.000      1
FIDUCIAL     7   circle   -7.000   25.000      1
FIDUCIAL     8   circle   -8.000   25.000      1
;         nb fid1 attr fid2 attr fid3 attr fid4 attr
ALIGNMENT    1    1    N    2    N    3    N    4    S
ALIGNMENT    2    5    0    6    0
ALIGNMENT    3    7    0    8    0
;     circuit item-code  component_id      x       y     phi  glob   loc
COMPONENT    1  c1_item1       comp_1  -1.000  20.000   0.000     1     2
COMPONENT    2  c2_item1       comp_2  -2.000  20.000  90.000     1     3
[ACTION]
; During board transport
TOOLBIT                      HD1           tst_tb_1
; After board clamping
FIDUCIAL                     FA1           1    2    3
TOOLBIT                      HD1           tst_tb_2
PICK                         HD1           1    c1_item1   FB1   1   1
PICK                         HD2           2    c2_item1   FB2   1   2
FLUX                         HD1           1    c1_item1   FLUX1
ALIGN                        HD1           1    c1_item1   CA1
ALIGN                        HD2           2    c2_item1   CA2
FIDUCIAL                     FA1           5    6
MOUNT                        HD1           1    c1_item1
FIDUCIAL                     FA1           7    8
MOUNT                        HD2           2    c2_item1
```

CHAPTER 8 Create and correct vision files

Table of Contents

8.1 Component vision files, break down

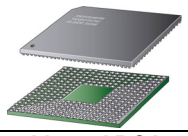
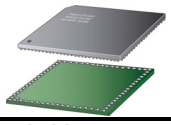
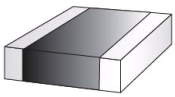
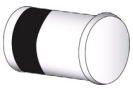
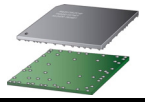
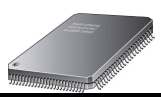
The machine uses component vision files to recognize components. In most cases it will be possible to use a component vision file from a component data base.

Creating a new component vision file can be done in two ways:

- Off line, use A-series Vision tool PA 1866/00
- On line, on the machine.

The way of working off line is similar to working on line, with the exception that the component vision file can not be tested for recognition.

The table below shows different component files and their definitions:

Component	Definition
BGA 	All bumps are in a grid.
CSP Flip chip and BGA 	All bumps are in a grid, one or more rows at each side.
Standard chip 	
Discrete leadless 	Component that can only be defined by “shapes”, (rectangles, circles, edges...).
Melf 	Cylinder shape
Flip chip 	All bumps are placed random
Bare die 	Leadless bare die (rectangular)
Other leadless 	
PLCC 	J-leads, 4 sided with equal amounts of leads on all sides
QFP 	Gull wing leads, 4 sided with equal amounts on opposite sides, (sometimes equal on all 4 sides).

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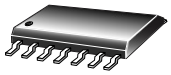
Component	Definition
SO 	Gull wing leads, 2 sided, equal amounts on both sides.
SOJ	J-leads, 2 sided, equal amounts on both sides.
SOT 	Gull wing leads, 2 sided, different amounts on both sides.
Discrete leaded 	Component with two leads (at the ends), that needs to be aligned using the leads
Other leaded 	Component defined with (multiple) lead groups, and not belongs to any of the other leaded categories.

Figure 119 Component packages and their definitions

8.2 Component vision files for AX-201

Following chapters describe how to:

- Modify or create a new component vision file, see 8.2.1.Component vision file, modify or create
- Test a component vision file, see 8.2.4.Component vision file, testing
- Correct a component vision file, see 8.2.5.Component vision file, correcting

8.2.1 Component vision file, modify or create

1. Log on as M&S engineer.

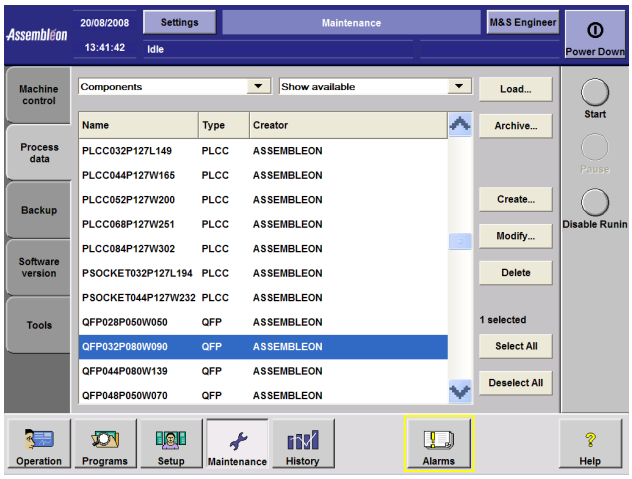


Figure 120

2. Select 'Maintenance' from the menu bar.
3. Select 'Process data'.
4. Select 'Components' from the pull down menu.
5. Select 'Create'.

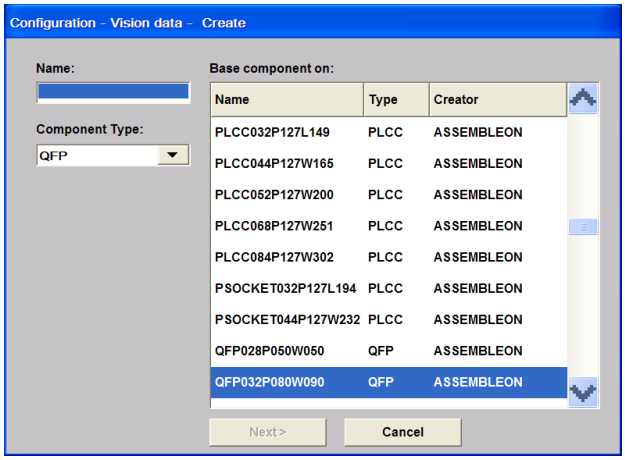


Figure 121

6. Enter a name for the new component.
7. Select the package.

8. Press 'Next'.

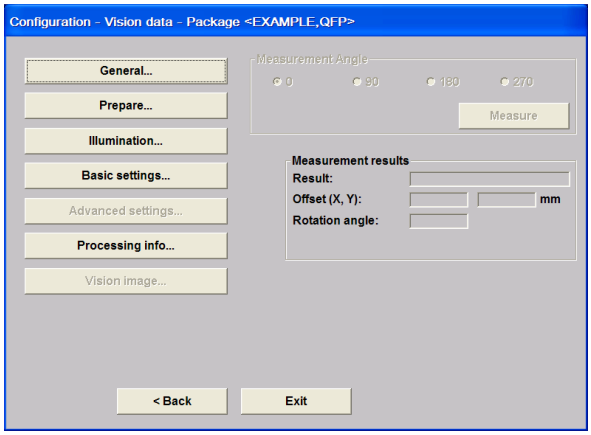


Figure 122

9. Click on 'General' to enter the screen where general package data can be entered.

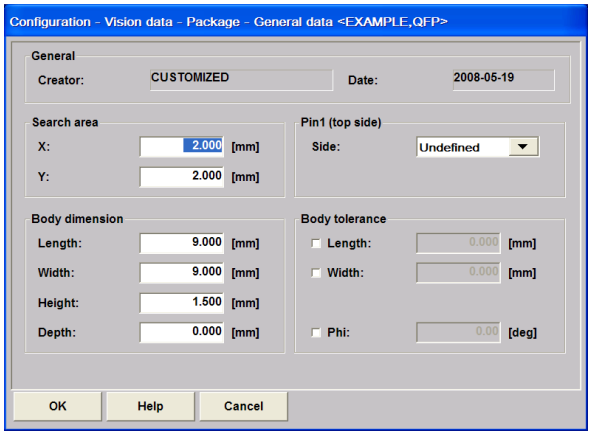


Figure 123

This screen provides an overview of general component data for package types that can be edited

- General data
  The creator and the creation date.
- Search area.
  Search area for the first lead.
- Body dimension.
  Length, Width, Height and Depth of the Body of the component.
- Pin1 (top side)
  The side where the machine must look for the first lead.
  Possible options: North, East, West and South.
- Body Tolerance.
  Length, Width and Phi tolerance.
  If NOT checked, a default value is used when measuring.
  If checked, the value specified is used. Value between 0 and 5.
- Button OK
  To close the window and save the changes in the current order program relation.
- Button CANCEL
  To close the window without saving changes.

10.Click on ‘Prepare’.

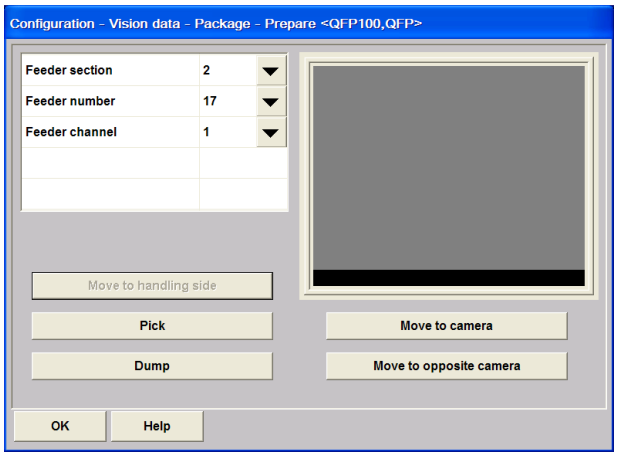


Figure 124

Depending on the state of the machine, the appearance of this screen changes;

- An order is running
  When an order is running the fields 'Feeder section', Feeder number' and 'Feeder channel' are visible.
  The '<Component name>' can be picked from the 'Feeder - number - channel' combination described in the running order.
  - FEEDER SECTION: Shows the available feeder section.
    Choose the feeder section to pick from.
  - FEEDER NUMBER: Shows the available feeder number.
    Choose the feeder number to pick from.
    - Feeder trolley: 1 - 27.
    - Tray Trolley; 1 - 30 (47).
  - FEEDER CHANNEL: Shows the available feeder channel.
    Choose the feeder channel to pick from.
    Choose 'MANUAL' see No order is running
  - PICK: To pick the component from the selected 'Feeder - number - channel' combination.
  - DUMP: To dump the component from the placement head.
    Depending on the component file in dump bin or re-use belt.
  - MOVE TO CAMERA: To move the component over the camera.
    A new screen with jog buttons will open.
  - MOVE TO OPPOSITE CAMERA: Only enabled in case 2 camera's are configured.
    To move the component over the second camera.
    A new screen with jog buttons will open.
  - OK: To close the window.
- No order is running.
  When no order is running the fields 'Feeder section' and 'Feeder number' are disabled. 'Feeder channel' is set to 'Manual'.
  The fields 'Head' and 'Nozzle' are now available. A component can be put onto the placement head by selecting the applicable head, 'Move to handling site' and 'Hold'.
  - FEEDER CHANNEL: Only one choice can be made: 'Manual'
  - Head: Shows all configured heads.
    Choose the head for the manual pick action.
    PH-HA or PH-DV On position 1, 2, 3 or 4.

- NOZZLE: Choose 'INNER' or 'OUTER'.
- INNER: only available on PH-HA heads.
- MOVE TO HANDLING SITE: To move the selected head to the handling site.
  - Front-right site of the machine if picked with head position 1 or 2.
  - Rear-left site of the machine if picked with head position 3 or 4.
- HOLD: To switch-on vacuum.
- RELEASE: To switch-off vacuum.
- MOVE TO CAMERA: To move the component over the camera.
  A new screen with jog buttons will open.
- MOVE TO OPPOSITE CAMERA: Only enabled in case 2 camera's are configured.
  To move the component over the second camera.
  A new screen with jog buttons will open.
- OK: To close the window.

11.Click on 'Illumination'.

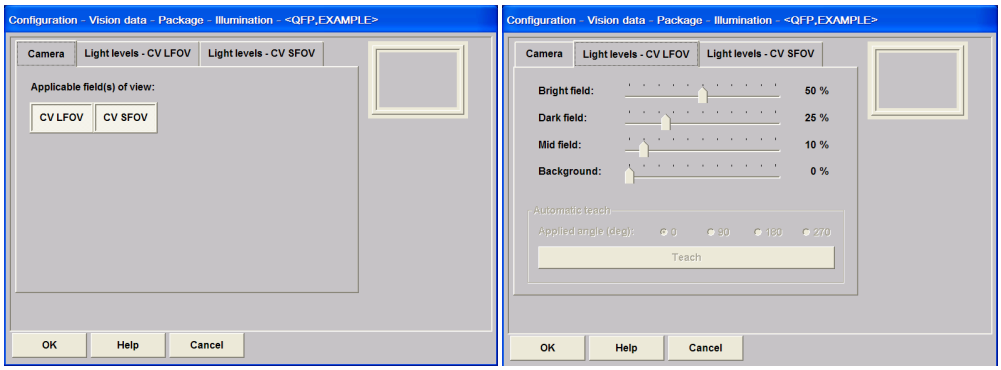


Figure 125

This dialogue defines the light levels to be applied during measurement. The levels can be changed by moving the sliders that exist for each camera illumination source. On the first tab page the applicable camera field of view can be defined, large (LFOV), small (SFOV) or both. At least one has to be defined.

The available illumination sources are:

- Brightfield illumination (LFOV/SFOV)
- Darkfield illumination (LFOV/SFOV)
- Midfield illumination (LFOV/SFOV)
- Background illumination (LFOV)

In case the machine robot is prepared for the selected camera field of view type it is also possible to determine the optimal light level mix automatically by pressing the Teach button.

Illumination parameters	
Camera	Indicates which camera is used.
Illumination	Indicates illumination for LFOV (Large Field Of View) or SFOV (Small Field Of View) camera respectively.Choose from: For **LFOV** or **SFOV** camera: **Dark field of view** is used for bumped components. This beam of light creates a shadow and makes the bumps visible for the camera. **Bright field of view** is used for leaded components This beam of light creates a reflection on the leads and makes the leads visible for the camera. **Back light** is used for odd components.

Illumination parameters	
Light level	Defines the light level for the selected illumination type in percentage of maximum light level.
Automatic teach	-

Figure 126

12. Click on 'Basic settings' to enter the screen where specific component data can be entered. This screen is different for each package type.

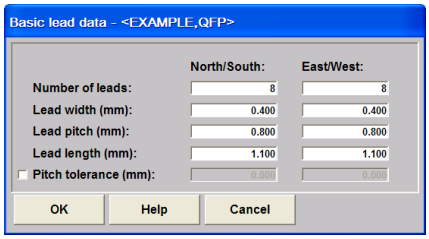


Figure 127

This function specifies all lead related data of the package type that is referred to in the screen header. The values are related to optical measurements of the package and need not be the same as the physical dimensions.

The following fields can be entered:

- Number of leads, present on the indicated side
- Lead width, the width of the leads (CA camera measurement)
- Lead pitch, the distance between the centres of the leads
- Lead length, the length of the leads (CA camera measurement)
- Pitch tolerance, allowed deviation of the lead pitch.
  When the check box is not checked, a default value is used when measuring.
  If the check box is checked, the value specified is used (where zero means that the pitch tolerance is not taken into account when measuring).

The table below lists the data that can be entered per package type.

Package type	What can be defined in the basic settings window?
CHIP	Nothing
CSP	Bump setting
Bump locations (including missing bumps)	-
FLIPCHIP	Bump setting
Bump locations (including individual bumps)	-
ODD	Lead locations and shapes, see Figure 129
Origin	-
PLCC / QFP	Lead data (2 groups: North/South & East/West)
SO / SOJ	Lead data (1 group: North/South)
SOT	Lead data (2 groups: North & South)
SPECIAL	Lead locations and shapes, see Figure 129
Settings	-

Figure 128

Select 'OK'.

- In the ' Basic Special Data <Component Name> screen the Lead location, Settings and Shape settings can be set.

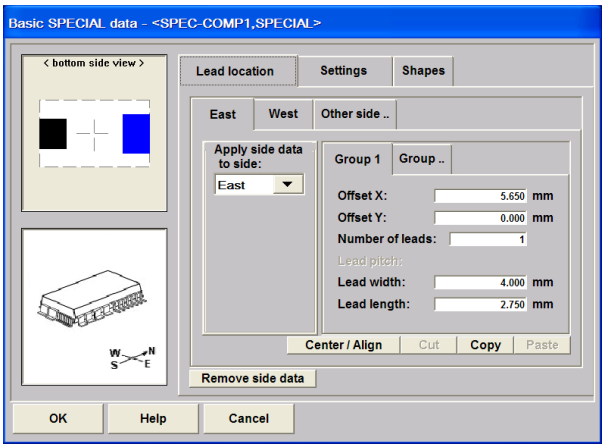


Figure 129

Select one of the component data definition tabs:

■ Lead Location
In this section the lead location is defined for lead groups.
A bottom side view from the body with all configured lead groups and shapes with their location and a 3D picture of the basic component.

- Tab Pages EAST, WEST, OTHER SIDE...
  A tab page for each defined lead group.
- Drop down list APPLY SIDE DATA TO SIDE
  To apply the selected data to a different lead group.
  Used when the information is identical.
- Tab Pages GROUP 1, GROUP...
  A tab page with the group information on the selected lead group.
- Text fields
  To set specific group information.
  Available options:
  - Offset X.
  - Offset Y.
  - Number of leads.
  - Lead pitch. Disabled if the number of leads is 1.
  - Lead width.
  - Lead length.
- Button CENTER/ALIGN
  To set the lead group on the centre of the X or Y axes of the components body.
- Button CUT, COPY and PASTE
  To cut, copy or paste group information from on into another group.
  Extra groups can be applied.
- Button REMOVE SIDE DATA
  To remove all information related to the selected lead location tab.
- Button OK: To close the window and save the changes.
  Button CANCEL: To close the window without saving changes.

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■ Settings

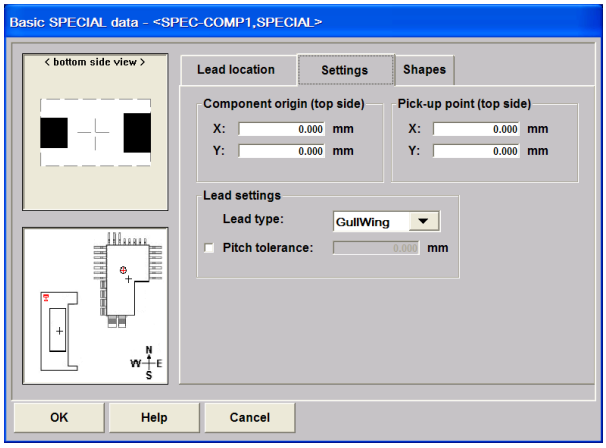

Figure 130

In this section changes to the component origin, pick up point and lead type can be made. A bottom side view from the body with the component origin, pick up point, lead groups and a 2D picture of the basic shape.

- COMPONENT ORIGIN
  Text field with the X and Y deviation of the component origin with reference to the component body. Be aware that this is a TOP SIDE view.
- PICK UP POINT
  Text field with the X and Y deviation of the pick up point with reference to the component origin. Be aware that this is a TOP SIDE view.
- LEAD TYPE
  To select the lead type of the component..
  Available options: GullWing, JLead.
- PITCH TOLERANCE
  To enable the pitch tolerance set in millimetres.

■ Shape

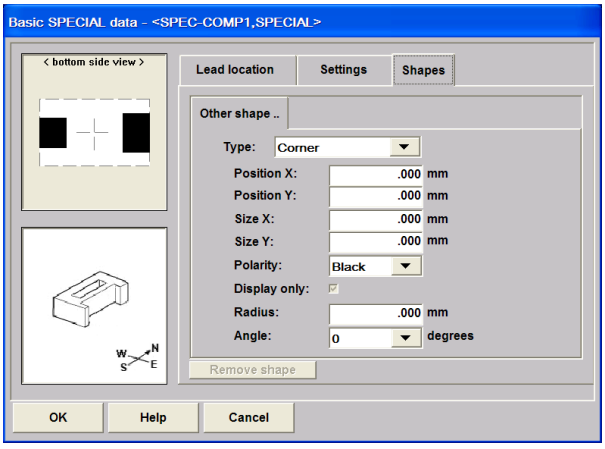

Figure 131

In this section shapes can be set and added in addition on the defined lead groups. Shapes are used as a help in aligning a component on the boards.

A bottom side view from the body with all configured lead groups and shapes with there location and a 3D picture of the basic component.

- SHAPE,1 OTHER SHAPE...A tab page with the shape information on the component.

- TYPE To set the type of the shape.
  Available options: Corner, Rectangle, Diamond, Ellipse.
  To set specific shape information.
  Available options:
  - Position X.
  - Position Y.
  - Size X.
  - Size Y.
  - Polarity. Black or white.
- Display Only: Shape will not be measured.
- Radius.
- Angle. 0, 90, 180 or 270 degrees.
- REMOVE SHAPE to remove the shape shown in the shape tab.
- OK to close the window and save the changes.
- CANCEL to close the window without saving changes.

13. Click on 'Processing info' to enter the screen where processing data can be entered.

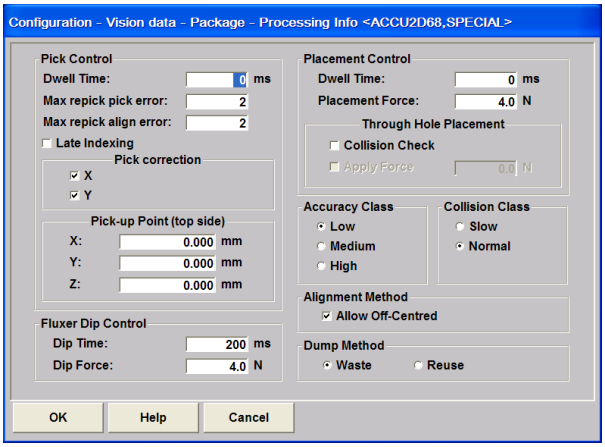

Figure 132

This screen provides an overview of general processing data for package types that can be edited

- Pick Control.
  - Dwell Time. Time the nozzle touches the component during pick (m.sec).
  - Max re-pick error. Maximum number of re picks after a pick error.
  - Max re-pick align error. Maximum number of re picks after a align error.
- Pick Correction.
  - Check box X. Enables the pick correction in X.
  - Check box Y. Enables the pick correction in Y.
- Pick-up Point (top side). X, Y and Z coordinate of the pick-up point.
  0, 0, 0, equals the centre of the body of the component.
- Fluxer Dip Control.
  - Dip Time. Time the component is dipped in the flux in milliseconds.
  - Dip Force. Force in which the component is dipped in Newton.
- Placement Control.
  - Dwell Time. Time the component touches the board during placement in milliseconds.
  - Placement Force. Force during placement in Newton.
- Trough Hole Placement.
  - Check box Collision check. To enable collision check during placement.

- Apply Force. The force that is checked during collision with a trough hole component in Newton.

- Accuracy class. Low, Medium and High.
  The 'Accuracy class' defines the maximum acceleration and deceleration used by the H-drive when handling a component.
  Which accuracy class to select depends on the combination of component size, mass and used nozzle type.
- Alignment Method, to enable allow off-centered alignment.
- Dump Method Waste and Reuse.
  To define the dump method of the component.
- OK to close the window and save the changes in the current order program relation.
- CANCEL to close the window without saving changes.

14. Select 'Vision'.
    - Use the live image to check the settings.

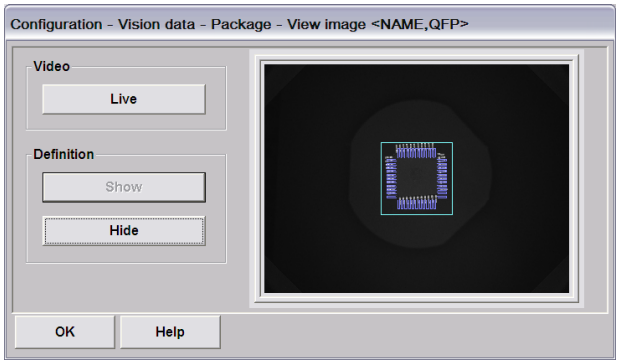

Figure 133

15. Click on Save to save the new component vision file to the controller or an external storage device.

8.2.2 Component vision files, archiving

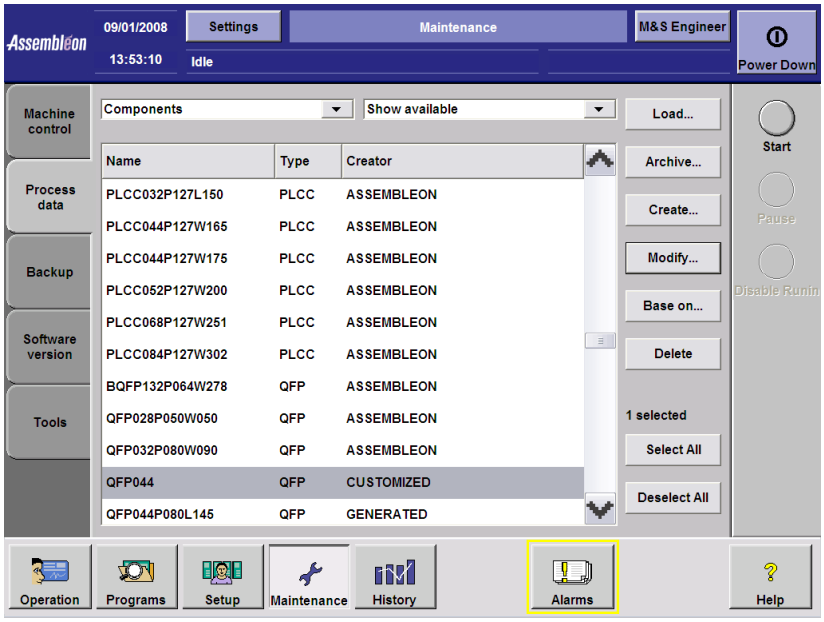

Figure 134 Component vision files, archiving

1. Log on as a M&S engineer.
2. Select 'Maintenance' from the menu bar.
3. Select 'Process data'.
4. Select components.
5. Select concerning component file(s) or 'Select all'.
6. Select 'Archive'.

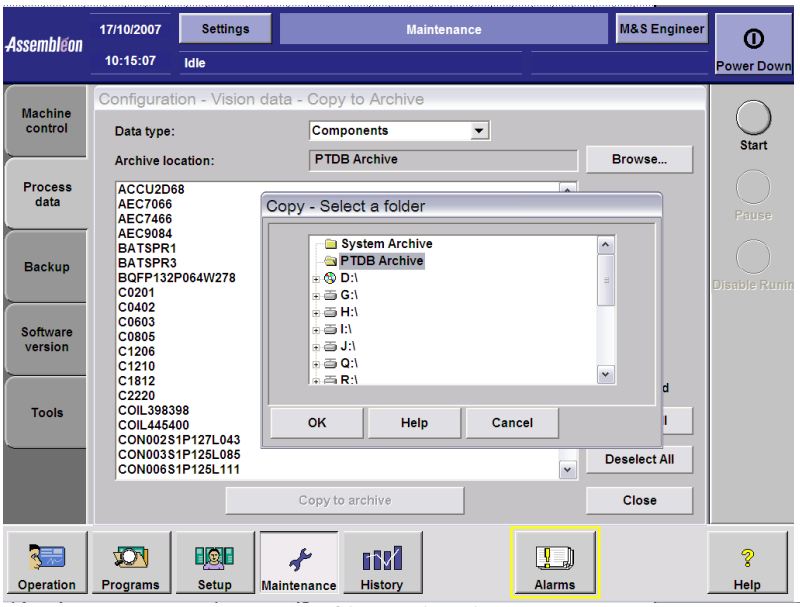

Figure 135 Component vision files, archive location

7. Browse for the desired directory.

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8.2.3 Component vision files, restoring

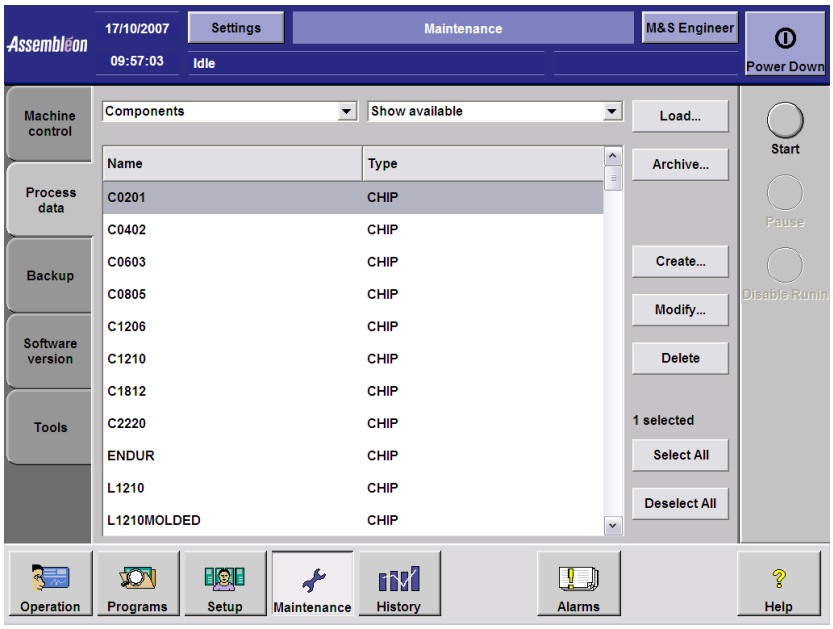

Figure 136 Component vision files, archiving

1. Log on as a M&S engineer.
2. Select 'Maintenance' from the menu bar.
3. Select 'Process data'.
4. Select 'Components'.
5. Select 'Load'.
6. Select 'Archive'.

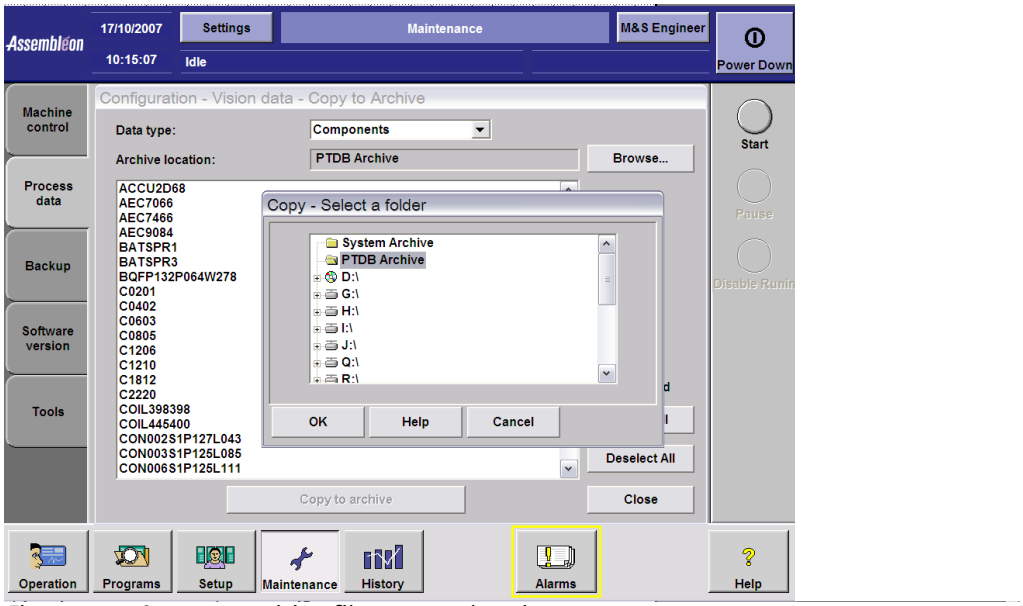

Figure 137 Component vision files, restore location

7. Browse for the desired directory.

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8.2.4 Component vision file, testing

1. Log on as a M&S engineer.
2. Select 'Maintenance' from the menu bar.
3. Select 'Process data'.
4. Select 'Components' from the pull down menu.
5. Select 'Open'.
6. Select the concerning component vision file from the pull down menu.
7. Press 'OK'.
8. Click on 'Prepare' to enter the screen where component transport can be controlled.
9. Select the 'Head' that must be used to pick up the component.
10. Select the 'Nozzle' (inner or outer) that must be used to pick up the component.
11. Click on 'Move to handling side' to bring the head to the side where the component will be placed under the nozzle.
12. Open the protection cover.
13. Click on 'Hold component' to turn on the vacuum on the nozzle
14. Place the component under the nozzle. Try to centre it as good as possible.
15. Click on 'Move to camera' or on 'Move to opposite camera' to bring the component to the camera of your choice.

WARNING: Make sure that you select a camera that is suitable for the component you wish to test. For instance, do not move large components to a small field of view camera.

16. Press 'OK'.
17. Click on 'Vision image'.
18. Select 'Live' to switch on the camera. Use the arrow keys to move the component to the centre.
19. Select 'Show' to show the boundaries of recognition on top of the component image.
20. If necessary make changes to the component vision file to optimize component recognition.
21. Save changes by clicking on 'Save'.

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8.2.5 Component vision file, correcting

The list below shows examples of recognition problems for different packages, and possible solutions. When a component is not recognized by the system try one of the solutions mentioned below and test it again as described in 8.2.4.Component vision file, testing

Package type	Problem	Possible solution
All types	Component image is larger than definition / Component is not recognized	Increase the "Body dimensions" and/or "Body tolerance" in "General" screen
All types	Component image is smaller than definition / Size is not optimal	Decrease the "Body dimensions" in "General" screen
All types	Illumination settings not optimal	Press "Auto teach" in the "Illumination" screen
CSP		
FLIPCHIP	Number of bumps not OK	Change number of bumps in the "General" screen
CSP		
FLIPCHIP	Bump pitch not OK	Change bump pitch in the "General" screen
PLCC QFP		
SO		
SOJ		
SOT		
SPECIAL	Number of leads not OK	Change number of leads in the "General" screen
PLCC QFP		
SO		
SOJ		
SOT		
SPECIAL	Lead pitch not OK	Change lead pitch in the "General" screen
ODD	Black/white recognition not OK	Change black/white setting in the "General" screen
ODD	Ruler position not OK	Change ruler position in the "General" screen
ODD	Ruler width not OK	Change ruler width in the "General" screen

Figure 138

8.3 Fiducial mark vision files

The machine uses fiducial mark vision files to recognize fiducial marks, pre-defined marks on the board.

The table below shows the different fiducial marks that can be recognized by the machine

Figure 139 Fiducials

Following chapters describe how to:

- Create a new fiducial mark vision file , see 8.3.1.Fiducial mark vision file, creating
- Test a fiducial mark vision file, see 8.3.2.Fiducial mark vision file, testing
- Correct a fiducial mark vision file, see 8.3.3.Fiducial mark vision file, correcting

8.3.1 Fiducial mark vision file, creating

1. Log on as a 'M&S engineer' (see 4.4.Log on).
2. Select 'Maintenance' from the menu bar.
3. Select 'Process data'.
4. Select 'Fiducial marks'.
5. Select 'Create'.
6. Enter a name for the new fiducial mark in the 'Type box'.
7. From the 'Class' menu, choose one of the following four options:

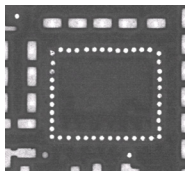
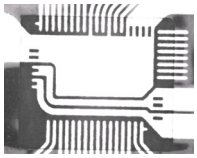
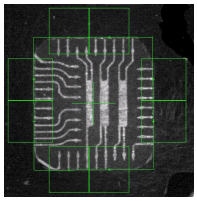
Fiducial mark type	Application	Example
ART_DOT	Dots that can be recognized within the artwork on the board	
ART_EDGE	Edges that can be recognized within the artwork on the board	
ART_LEAD	Leads that can be recognized within the artwork on the board	
SHAPE	Pre-defined shapes that are not part of the artwork, but placed on the board as reference marks	

Figure 140

8. Press 'OK'.
9. Click on 'General' to enter the name of the creator of this file
10. Click on 'Basic settings' to enter the screen where specific fiducial mark data can be entered. This screen is different for each fiducial mark type. The table below lists the data that can be entered per fiducial mark type.

Fiducial mark type	What can be defined in the basic settings window?
ART-DOT	Bump settings
Bump location	-
ART_EDGE	Edge location
ART_LEAD	Lead location
SHAPE	Shape definitions
Size	-
Search area	-
Shape specific parameters	-

Figure 141

11. Click on ‘Illumination’ to enter the screen where illumination data can be entered.
    Enter the percentage of "bright field" (direct) light and "dark field" (indirect) light to be used. It is also possible to have the system test for the best illumination settings, by selecting "Teach".
12. Click on ‘Save’ to save the new fiducial mark vision file to the controller or an external storage device.

8.3.2 Fiducial mark vision file, testing

1. Log on as a 'M&S engineer' (see 4.4.Log on).
2. Select 'Maintenance' from the menu bar.
3. Select 'Process data'.
4. Select 'Fiducial marks' from the pull down menu.
5. Select 'Open'.
6. Select the fiducial mark vision file you want to test from the pull down menu.
7. Press 'OK'.
8. Click on 'Prepare'.
9. Select a Board Alignment camera from the pull down menu at the right top.

NOTE: FA1 is the BA camera at the front
FA2 is the BA camera at the back (if present)

10. Click on 'Load PCB'.
11. Click on 'Move to fiducial'.
12. Click on 'Unload PCB' and collect the board from the run out area.
13. Save changes by clicking on 'Save'.

8.3.3 Fiducial mark vision file, correcting

The list below shows examples of recognition problems for different fiducial marks, and possible solutions. When a fiducial mark is not recognized by the system, try one of the solutions mentioned below and test it again as described in chapter 8.3.2.Fiducial mark vision file, testing

Fiducial mark type	Problem	Possible solution
All types	Fiducial mark image is larger than definition / Fiducial mark is not recognized	Increase the "Size" in the "Basic settings" screen
All types	Fiducial mark image is smaller than definition / Size is not optimal	Decrease the "Size" in the "Basic settings" screen
All types	Illumination settings not optimal	Press "Teach" in the "Illumination" screen, or manually adjust the illumination settings
ART-DOT		
ART_EDGE		
ART_LEAD		
SHAPE		

Figure 142

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8.4 Bad mark vision files

On the machine it is possible to define bad marks. When the machine detects a bad mark, it will not place components on the related board or circuit.

The way of working off line is similar to working on line, with the exception that the bad mark vision file can not be tested for recognition.

Following chapters describe how to:

- Create a new bad mark vision file, see 8.4.1.Bad mark vision file, create a new one
- Test a bad mark vision file, see 8.4.2.Bad mark vision file, testing
- Correct a bad mark vision file, see 8.4.3.Bad mark vision file, correcting

In general the way of creating, testing and correcting a bad mark vision file is similar to fiducial vision files.

8.4.1 Bad mark vision file, create a new one

1. Log on as a 'M&S engineer' (see 4.4.Log on).
2. Select 'Maintenance' from the menu bar.
3. Select 'Process data'.
4. Select 'Bad marks' from the pull down menu.
5. Select 'Create'.
6. Enter a name for the new bad mark in the 'Type box'.
7. Press 'OK'.
8. Click on 'General' to enter the name of the creator of this file.
9. Click on 'Basic settings' to define the colour, size and threshold for the bad mark.
10. Click on 'Illumination' to enter the screen where illumination data can be entered.
    Enter the percentage of "bright field" (direct) light and "dark field" (indirect) light to be used.
11. Click on 'Save' to save the new bad mark vision file to the controller or an external storage device.

8.4.2 Bad mark vision file, testing

1. Log on as a 'M&S engineer' (see 4.4.Log on).
2. Select 'Maintenance' from the menu bar.
3. Select 'Process data'.
4. Select 'Bad marks' from the pull down menu.
5. Select 'Open'.
6. Select the bad mark vision file you want to test from the pull down menu.
7. Press 'OK'.
8. Click on 'Prepare'.
9. Select a Board Alignment camera at the left top.

NOTE: FA1 is the BA camera at the front
FA2 is the BA camera at the back (if present).

10. Click on 'Load PCB'.
11. Click on 'Set camera'.
12. Click on 'Unload PCB' and collect the board from the run out area.
13. Save changes by clicking on 'Save'.

8.4.3 Bad mark vision file, correcting

The list below shows examples of recognition problems for different bad marks, and possible solutions.

When a bad mark is not recognized by the system, try one of the solutions mentioned below and test it again as described in chapter 8.4.2.Bad mark vision file, testing

Problem	Possible solution
Bad mark image is larger than definition / Bad mark is not recognized	Increase the "Size" in the "Basic settings" screen
Bad mark image is smaller than definition / Size is not optimal	Decrease the "Size" in the "Basic settings" screen
Illumination settings not optimal	Adjust the illumination settings

Figure 143

UM-00050.fm

CHAPTER 9 Manufacturing Information System (MIS)

Table of Contents

9.1 MIS reports, standard

When MIS data collection has taken place the MIS data is stored in a special database. In this chapter only user interface functions for obtaining the standard MIS screens and reports are described.

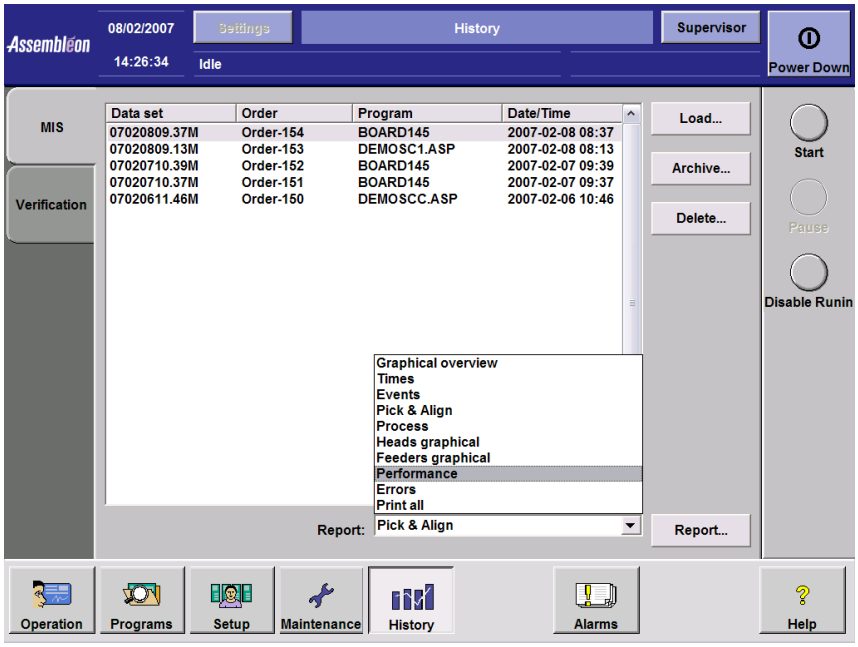

Figure 144 MIS reports

1. Select 'History'
2. Select desired information
3. Select 'Report'.

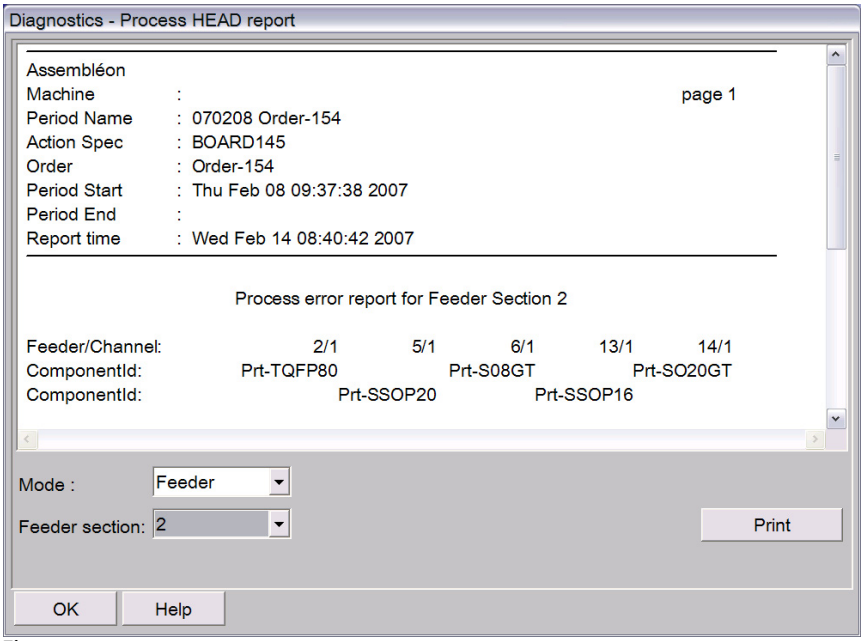

Figure 145

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9.1.1 Report

Selecting <**Report**> shows the screen that lists the available periods (of previous production) for which textual and graphical reports have been made (Figure 146). A maximum of 100 periods are available. The required period is selected and then the function.

Full MIS data will only be retrieved after <**Collect...**> or <**Close Period...**> actions. When the order has been completed MIS data is automatically retrieved.

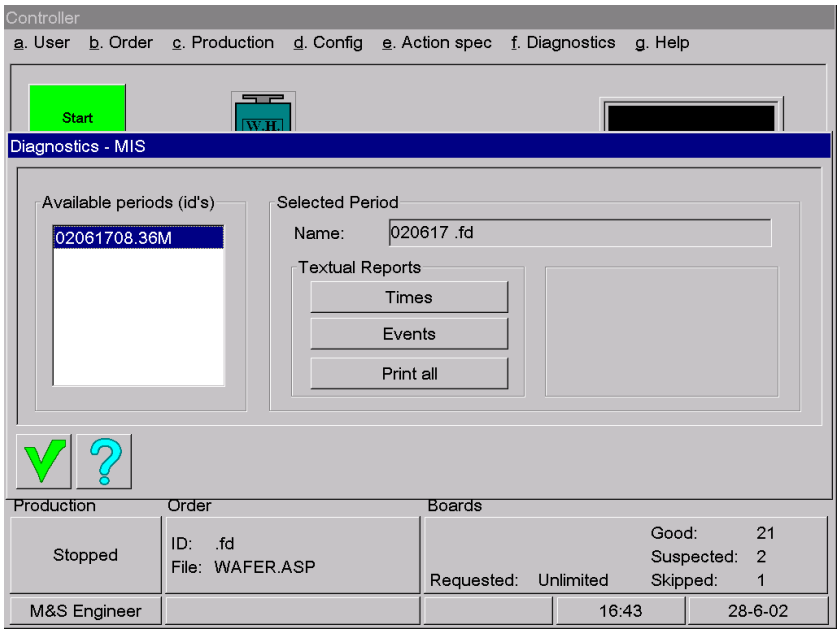

Figure 146 Diagnostics

9.1.1.1 Textual Report - Times

Selecting <**Times**> shows a report on the times for the selected period (Figure 147). The report includes detailed information on all parameters that have contributed to the production time of the system. Also the total amount of elapsed time is reported. Where the report is too long to fit on a single screen, the scroll function

is used to reveal the hidden text. Selecting <**Print**> allows a hard copy of this report. Figure 148 gives a brief explanation of each field.

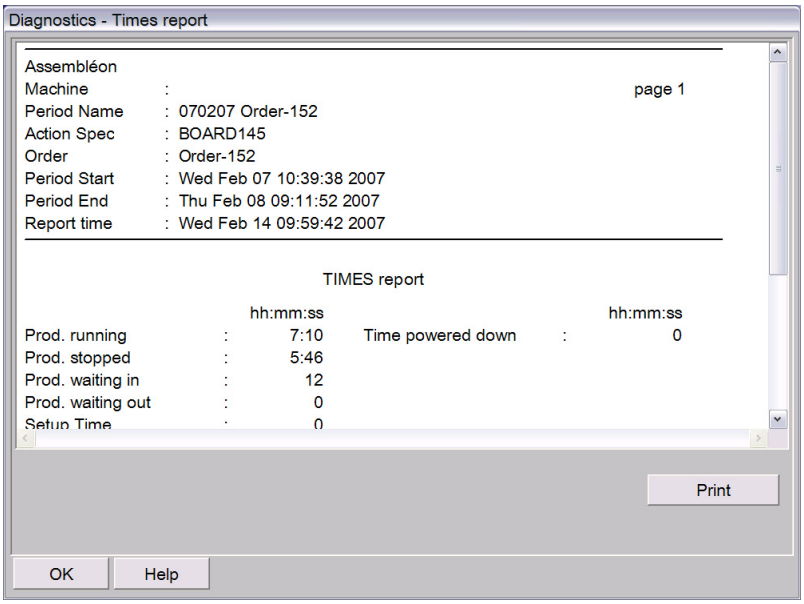

Figure 147 Times Report

FIELD NAME	MEANING OF FIELD
Prod. running	The amount of time the machine was in the RUNNING state
Prod. stopped	The amount of time the machine was in the STOPPED state
Prod. waiting	The amount of time the machine was in the WAITING state
Set-up time	The amount of time that was required by the operator to verify the set-up of the machine after a order change-over to a new order
Error time	The amount of time the machine was stopped due to an error cause
Total up-time	The SUM of RUNNING, STOPPED, WAITING, SET-UP and ERROR times
Total elapsed time	The sum of total up and down time This is the time from period start to period end or when the period has not ended the report time
Number of processed boards	The total number of boards that have gone through the machine
Average cycle time during production	Calculated average of the cycle time for one board during the time that the machine was in running state (running time/number of boards)
Average cycle time during current order	Calculated average of the cycle time (Total elapsed time/number of boards)
Number of components mounted	The total number of components that has been mounted by the machine

Figure 148 Times Report Fields

9.1.1.2 Textual Report - Events

Selecting <Events> shows a report on the events during the selected period (Figure 149). All error occurrences and events that have led to production interruption or delay are totalled and written in this report.
The fields are explained in Figure 150.

Two types of values are presented:

- Absolute: the number of errors that occurred during this MIS period.

- PPM: the parts per million error value (number of occurrences/number of picked components) * 10^6).

Where the event is too long to fit on a single screen, the scroll function is used to reveal the hidden text. Selecting **<Print>** allows a hard copy of this report.

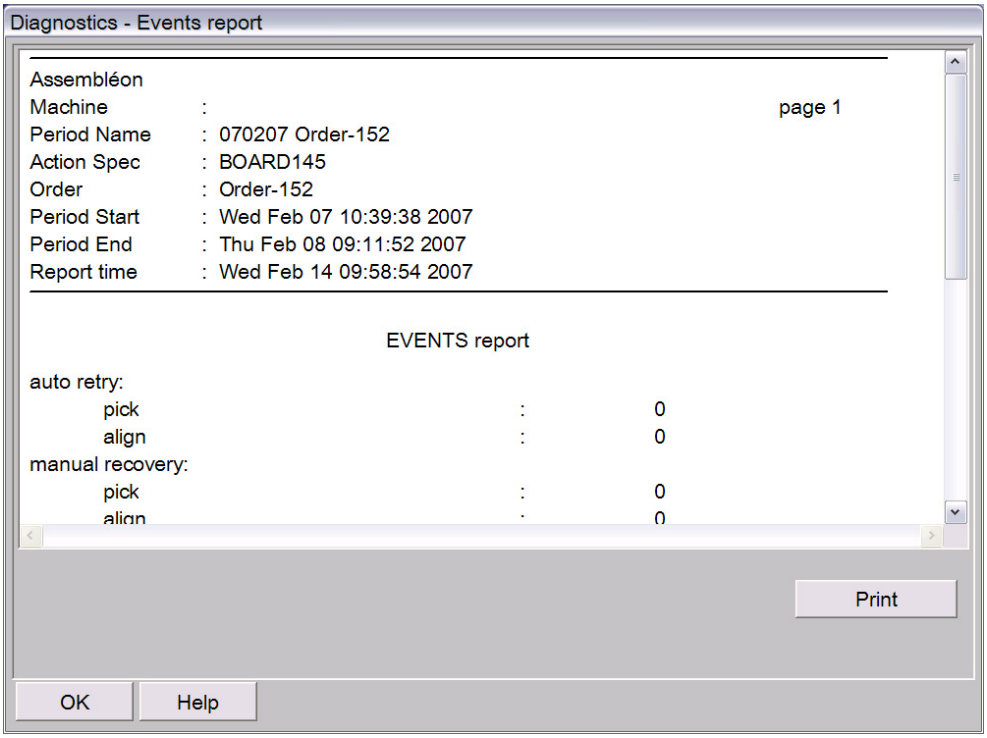

Figure 149 Events Report

FIELD NAME	MEANING OF FIELD
Auto re pick	Number of automatic retries after the first attempt to pick up a component
Auto retry CA	Number of automatic retries caused by failure of alignment
Manual retries - pick error	Manual retry actions that have been done because here were component pickup problems
Manual retries - missing before CA	Number of times a component has disappeared just prior to alignment (this is often to do with a nozzle vacuum check)
Manual retries - misalign	Manual retry actions that have been done because alignment failed
Manual retries - missing before place	Number of times a component had disappeared just prior to placement (this is often to do with a nozzle vacuum check)
Manual retries - retained after place	Number of times a component turned out to be present just after the placement action has been performed (often vacuum turn-off timing problem are vacuum levels ok? is the nozzle good? etc.)
Total manual retries	Sum of all actions where the operator had to perform some kind of retry action
Machine errors	Total of errors that took place during this MIS period
Retry - FA (spare used)	Retry actions of attempts to find fiducial markers including attempts to find spare markers
FA measurement error	Number of times fiducial alignment failed
Placed components	Total number of components that have been placed during this MIS period

FIELD NAME	MEANING OF FIELD
Picked components	Total number of components that have been picked up during this MIS period
Measured FA fiducials	Total number of fiducial alignment actions with successful results during this MIS period
Boards produced - good	Total number of good boards that have been produced during this MIS period
Boards produced - suspect	Total number of suspected boards that have been produced during this MIS period
Boards produced - skipped	Total number of skipped boards during this MIS period

Figure 150 Events Report Fields

9.1.1.3 Textual Report - Print All

This dialogue can be selected when a printed version of multiple reports is required (Figure 146). When the **<Print All>** button is selected all reports for the period are printed.

9.1.2 Collect

To collect data press f. (Diagnostics) - 1. (MIS) - 2. (Collect). Before starting data collection, a dialogue is presented informing the user that data collection may take a considerable amount of time (Figure 151). For obtaining a complete MIS report, before the order is finished, it is essential that data collection takes place. It is possible to make MIS reports without data collection but then not all data will be available.

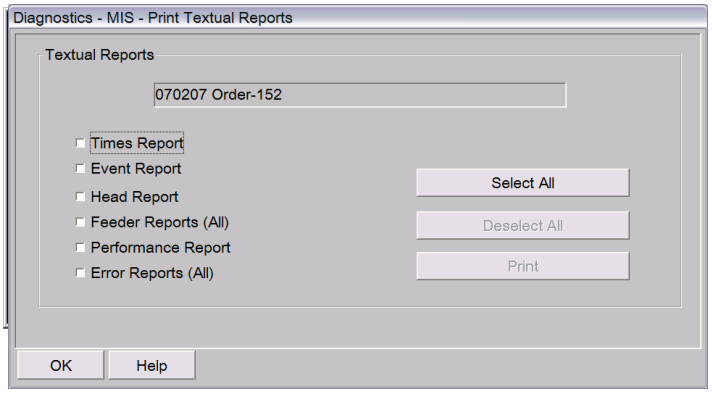

Figure 151 Controller Information - Data Collection

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9.1.3 Close

To close a period press f. (Diagnostics) - 1. (MIS) - 3. (Close Period). Before closing data collection, a dialogue is presented informing the user that this may take a considerable amount of time (Figure 152). For obtaining a complete MIS report it is essential that data collection takes. It is possible to make MIS reports without data collection but then not all data will be available. When an order is finished data collection will automatically be closed.

Figure 152 Controller Information - Closing

9.1.4 MIS files, load, archive

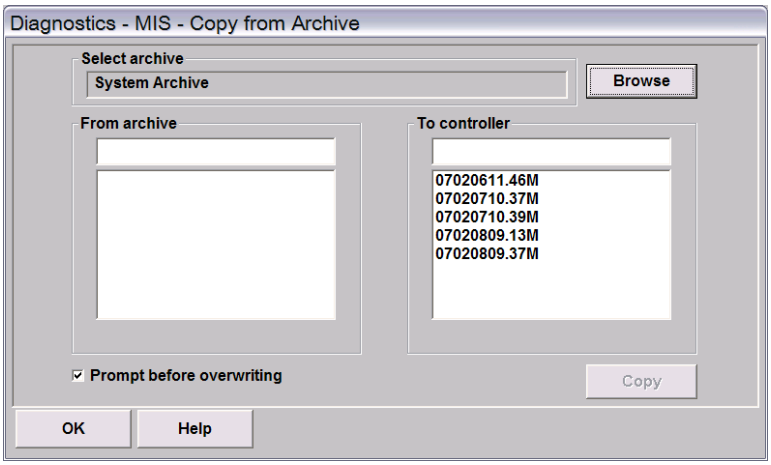


Figure 153 MIS - Copy from Archive

Load, copy from database

This function copies MIS data from either the internal archive of the System Controller or from a diskette into the MIS database.

Archive, copy to archive

This function copies MIS data to an archive, either internal on the System Controller or on a diskette. This function will not delete the MIS data.

9.1.5 MIS files, delete

This function deletes MIS data from the system controller (Figure 154). In case the data is valuable, the copy to archive function can be used to store the MIS data before this function is executed.

Figure 154 MIS - Delete

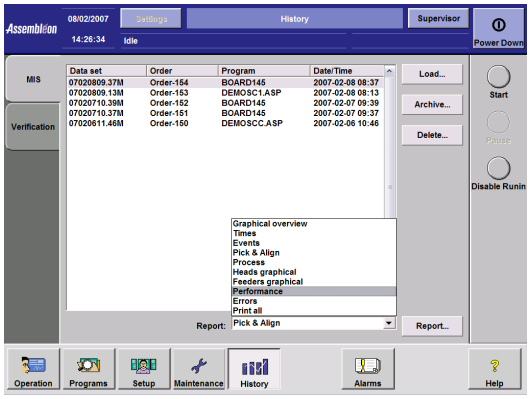
9.2 MIS reports, extended

'Extended MIS' is an addition to the standard MIS function and includes all standard MIS functions. Like the standard MIS it is selected with keys **<F> <1>** and the functions are selected with keys **<1>** thru **<6>**. All of the reports, both textual and graphical, are available with the extended MIS. For details of the diagnostic functions please see CHAPTER 9.Manufacturing Information System (MIS)

9.2.1 Extended MIS (PA 2445/10)

The extended MIS includes all of the standard MIS functions and expands the standard MIS functions. All of the reports, both textual and graphical (Figure 155), are available with the extended MIS.

Only examples of the extended functions that are available with the extended MIS are detailed.



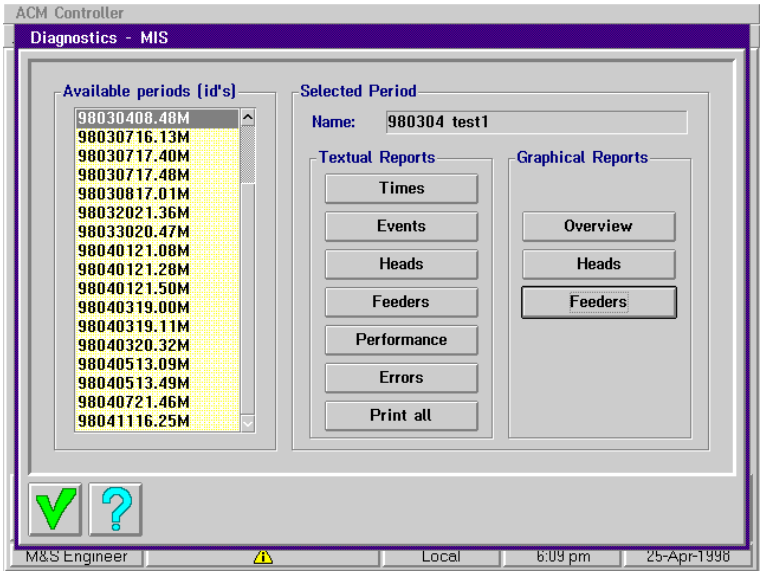


Figure 155 Extended MIS Diagnostics

9.2.2 Textual Report - Heads

Selecting **<Heads>** shows a report on the heads for the selected period (Figure 156). All error occurrences of heads that have led to production interruption or delay are written in this report. Where the details of the heads are too long to fit on a single screen, the scroll function is used to reveal the hidden text. Selecting **<Print>** allows a hard copy of this report. Figure 157 gives an explanation of the process head reports.

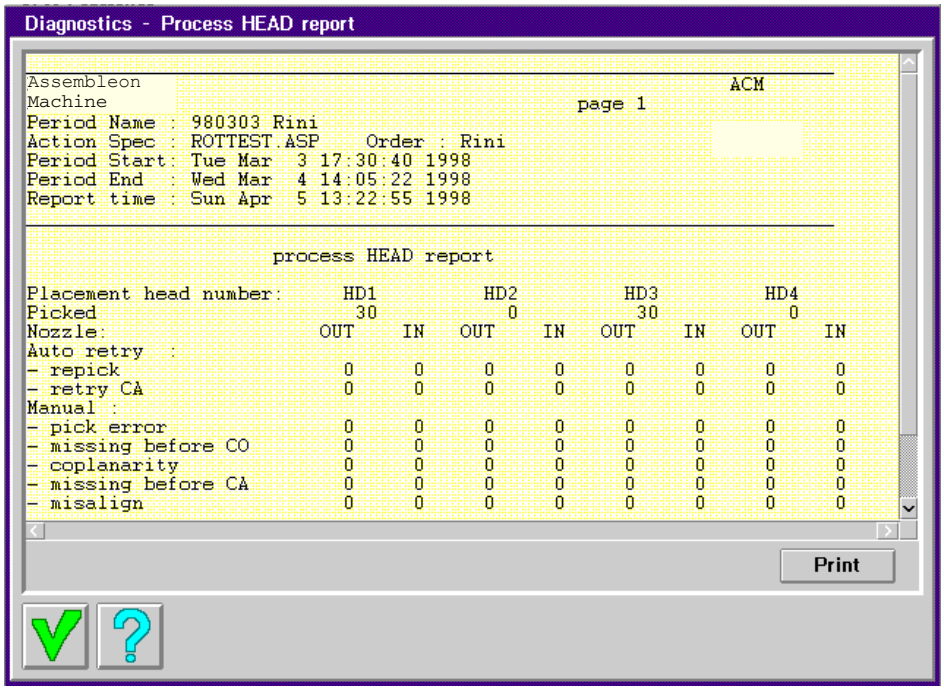


Figure 156 Process Head Report

FIELD NAME	MEANING OF FIELD
Placement head number	Head number on the system
Picked	Number of components that have been picked by the head from the specified feeder/channel position
Nozzle	Either the outer or the inner nozzle
Auto retry - repick	Number of automatic retries after the first attempt to pick up a component
Auto retry - retry CA	Number of automatic retries caused by rejection during the component alignment action after first attempt of that action
Manual - pick error	Number of manual started retries after a pick error has occurred
Manual - missing before CA	Number of times a component was missing before the component alignment had to be performed
Manual - misalign	Number of times a component could not be aligned (alignment went wrong)
Manual - missing before place	Number of times a component turned out to have disappeared just prior to placement (often this has to do with a nozzle vacuum check)
Manual - retained after place	Number of times a component turned out to be present just after the placement action has been performed (often vacuum switch-off timing problem are vacuum levels ok? is the nozzle good? etc.) turn

Figure 157 Process Head Reports

9.2.3 Textual Report - Feeder

Selecting <**Feeder**> shows a report on the selected feeder <1> for the period (Figure 158). Where the report is too long to fit on a single screen, the scroll function is used to reveal the hidden text. Selecting <**Print**> allows a hard copy of this report.

It is possible to obtain a report based on another feeder section by selecting the section and activating the <**Show**> button. Figure 159 gives an explanation of the feeder process reports.

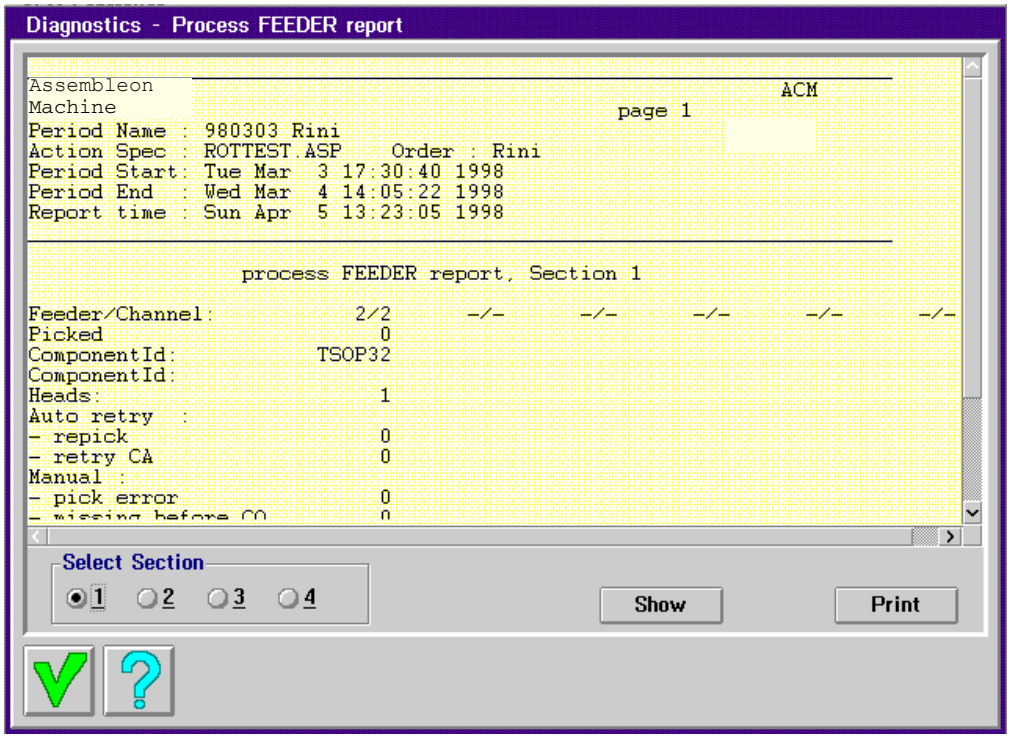


Figure 158 Process Feeder Report

FIELD NAME	MEANING OF FIELD
Feeder/Channel	Feeder number and channel of the feeder (when the feeder has more channels then these are numbered 1..n) A channel is a pick up position on the feeder itself
Picked	Number of components that have been picked by the head from the specified feeder/channel position
Component ID	Identification code of a component
Component ID	Identification code of a component
Heads	Number representing heads used
Auto retry - repick	Number of automatic retries after the first attempt to pick up a component
Auto retry - retry CA	Number of automatic retries caused by rejection during the component alignment action after first attempt of that action
Manual - pick error	Number of manual started retries after a pick error has occurred
Manual - missing before CA	Number of times a component was missing before the component alignment had to be performed
Manual - misalign	Number of times a component could not be aligned (alignment went wrong)
Manual - missing before place	Number of times a component turned out to have disappeared just prior to placement (often this has to do with a nozzle vacuum check)

FIELD NAME	MEANING OF FIELD
Manual - retained after place	Number of times a component turned out to be present just after the placement action has been performed (often vacuum switch-off timing problem are vacuum levels ok? is the nozzle good? etc.) turn

Figure 159 Process Feeder Reports

9.2.4 Textual Report - Performance

Selecting **<Performance>** shows a report on the performance of the system for the period (Figure 160). The report provides information about the performance of the system on its past placement program. Where the report is too long to fit on a single screen, the scroll function is used to reveal the hidden text.
Selecting **<Print>** allows a hard copy of this report.

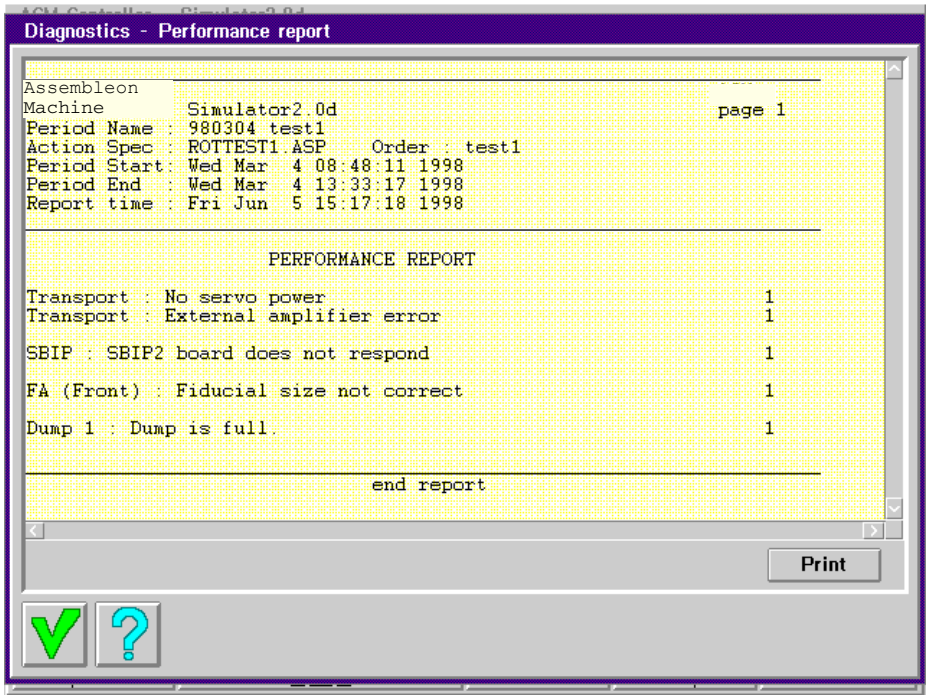


Figure 160 Performance Report

9.2.5 Textual Report - Error

Selecting **<Error>** shows a machine error report. The report provides information about the errors that have occurred during the period. The error type can be selected with **<Mch>** (machine error report, see Figure 161) or **<Prc>** (process error report, see Figure 162). **<Show>** can be selected for details on a particular error. Where the report is too long to fit on a single screen, the scroll function is used to reveal the hidden text. Selecting **<Print>** allows a hard copy of this report.

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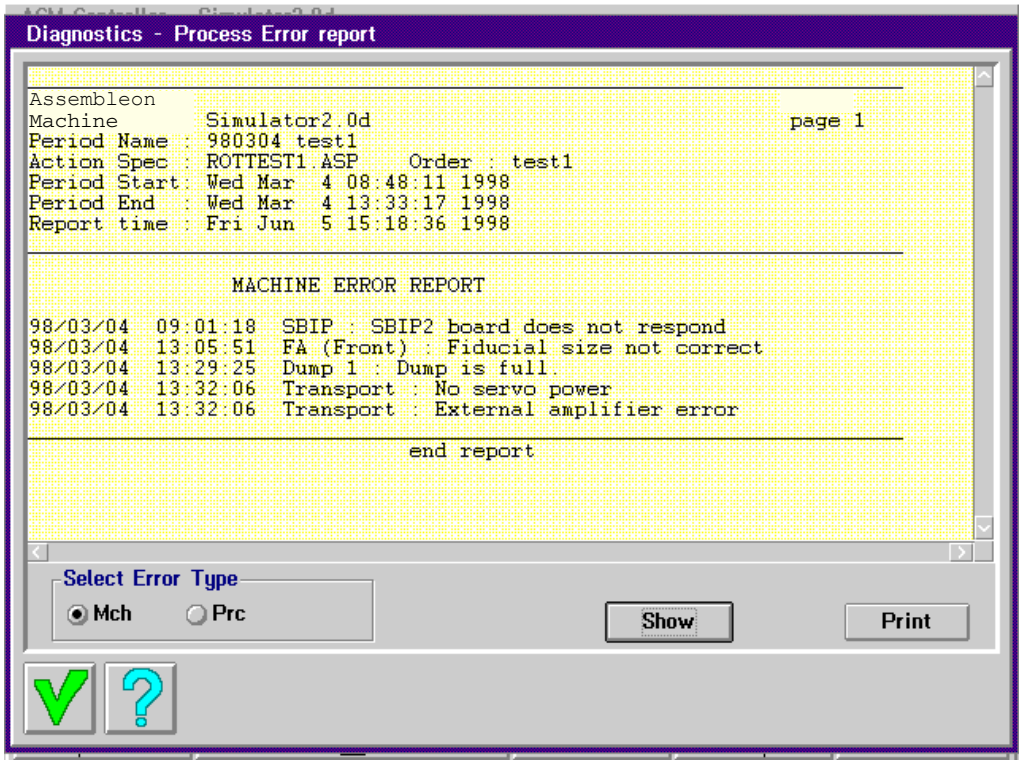

Figure 161 Process Error Report (Mch)

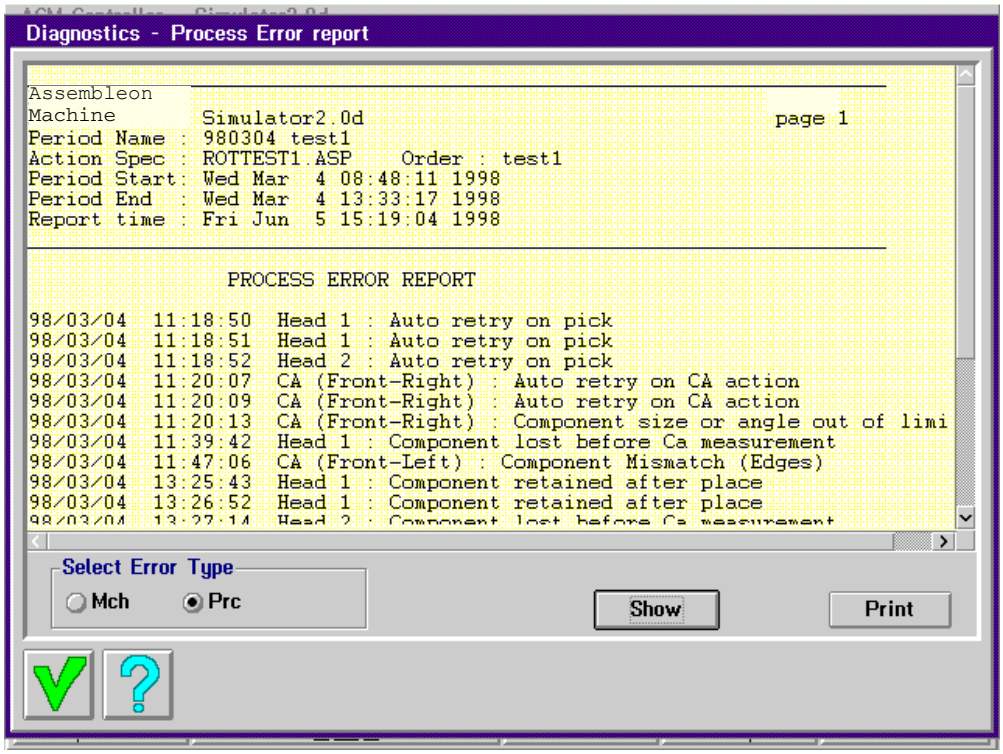

Figure 162 Process Error Report (Prc)

9.2.6 Textual Report - Print All

This dialogue can be selected when a printed version of multiple reports is required (Figure 163). When the **<Select All>** button is selected, all of the boxes to the left of the report captions will show ticks. The user will then have a selection of **<Deselect All>** and **<Print>**. Selecting **<Print>** will print all reports for the period.

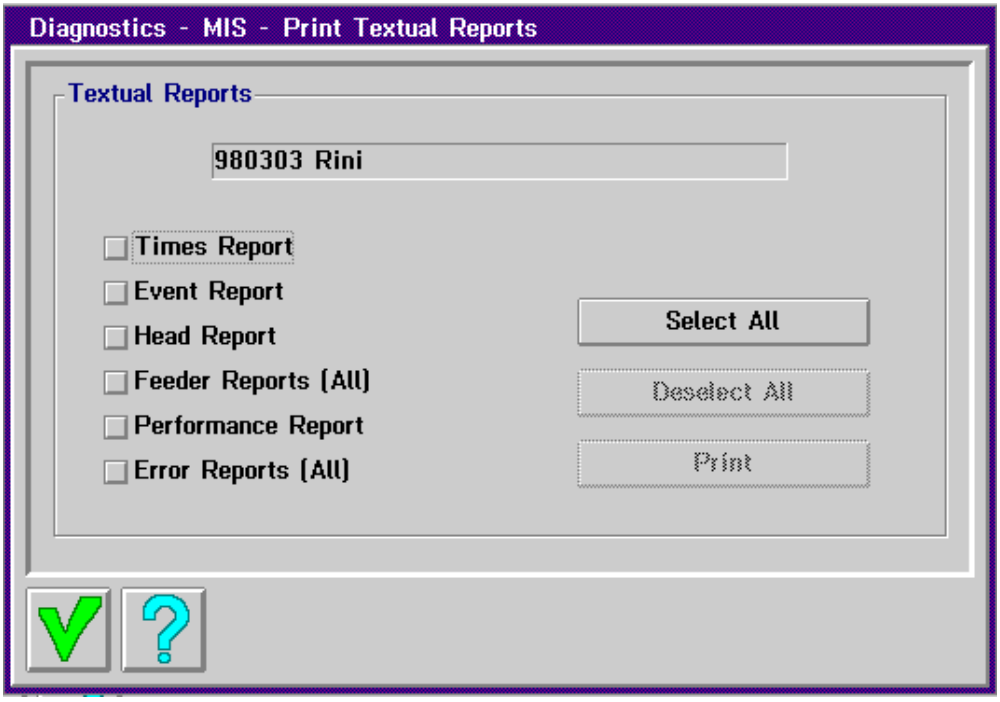

Figure 163 Print Textual Reports

9.2.7 Graphical Report - Overview

The errors per head/section are shown in barcharts. Selecting **<Print>** prints the graph (Figure 164). The **<Show PPM>** changes the display format (Figure 165) and then the **<Show>** returns the original format.

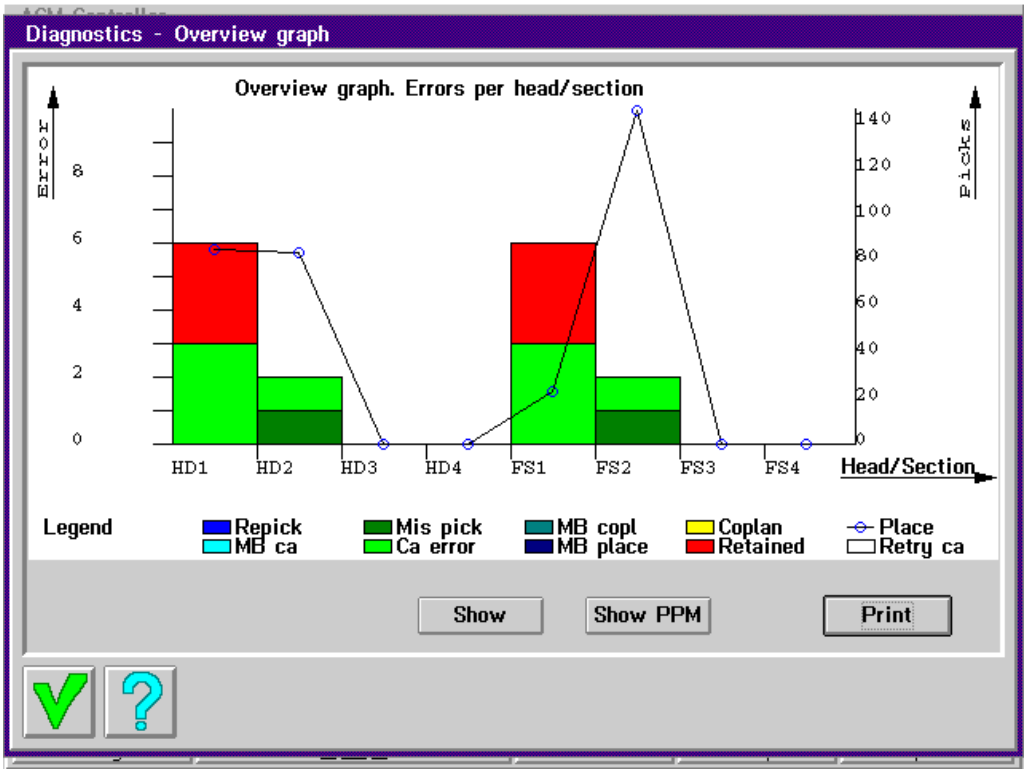

Figure 164 Overview Graph

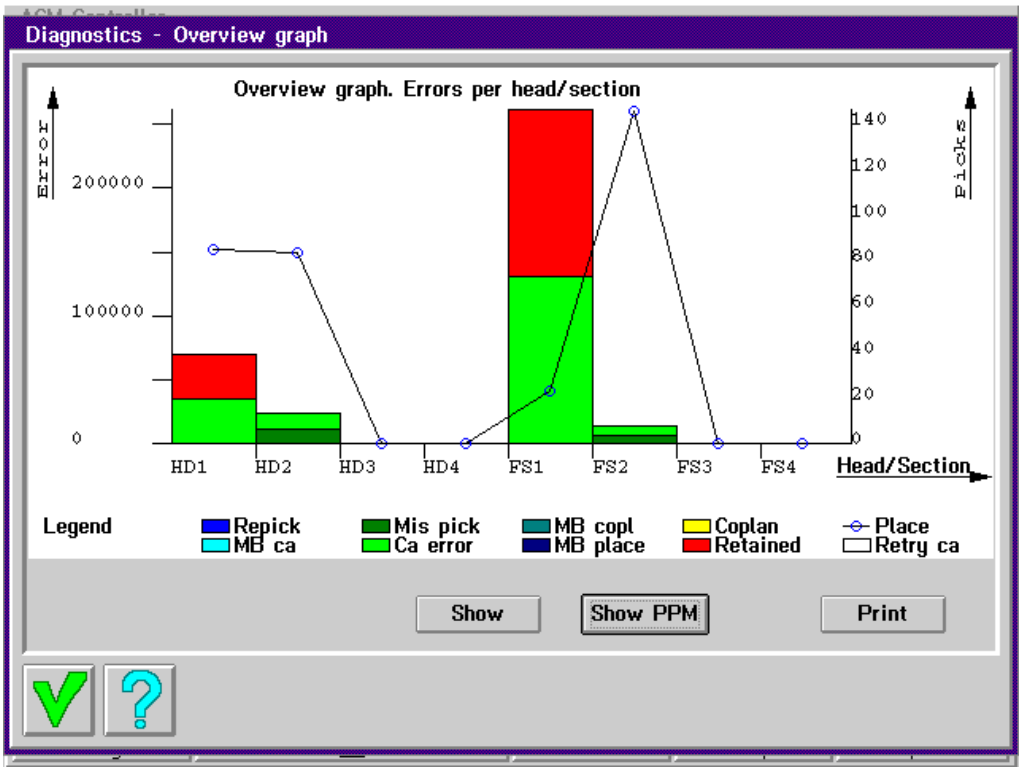

Figure 165 Overview Graph (PPM)

9.2.8 Graphical Report - Heads

A graph is provided for each head. The process errors, relating to the head, per feeder (all feeder sections) are shown as stacked bars in barcharts using the same categories as those in the process reports. Only absolute numbers are available.
Selecting **<1>** shows a graph (Figure 166) of head 1 for the period [980304].
Selecting **<2>** and then **<Show>** will show the graph for head 2 (Figure 167).
Selecting **<3>** or **<4>** and then **<Show>** will do the same for heads 3 and 4.

Selecting **<Print>** will cause the current graph to be printed

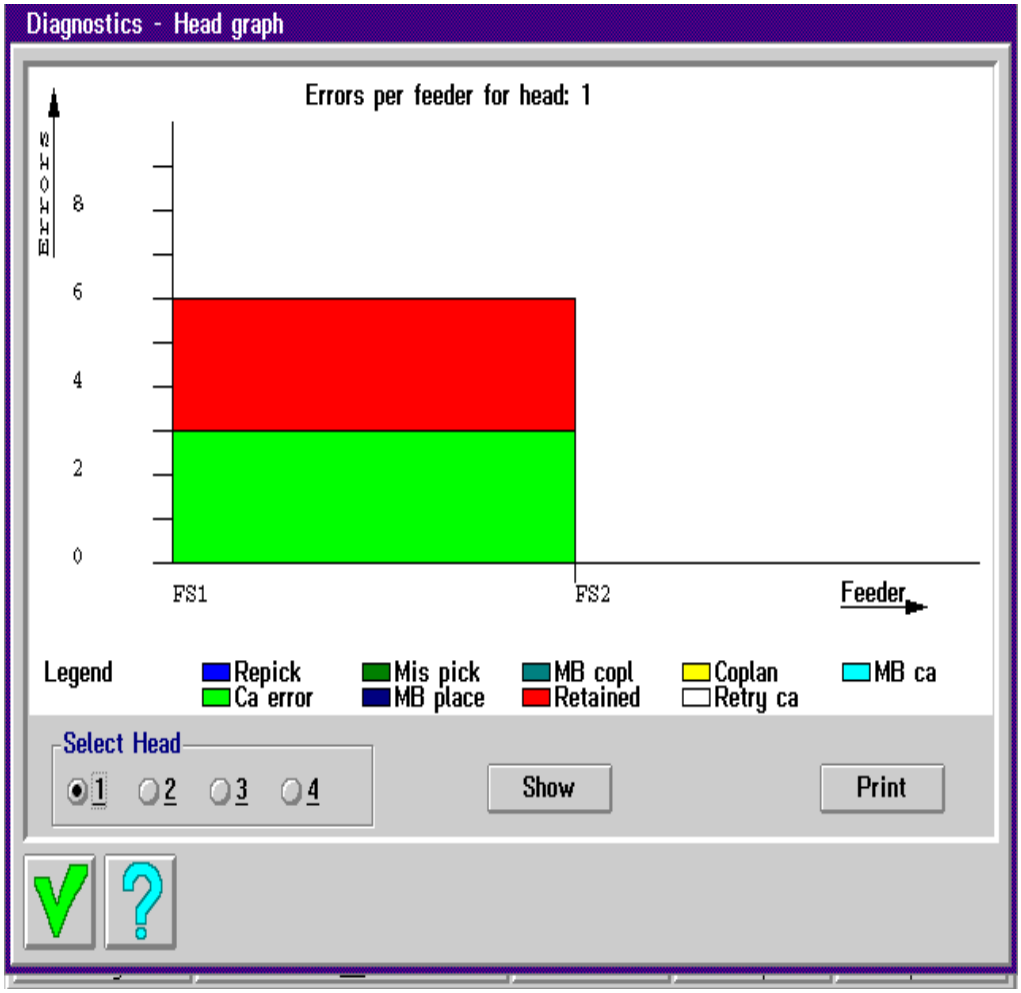

Figure 166 Head 1 Graph

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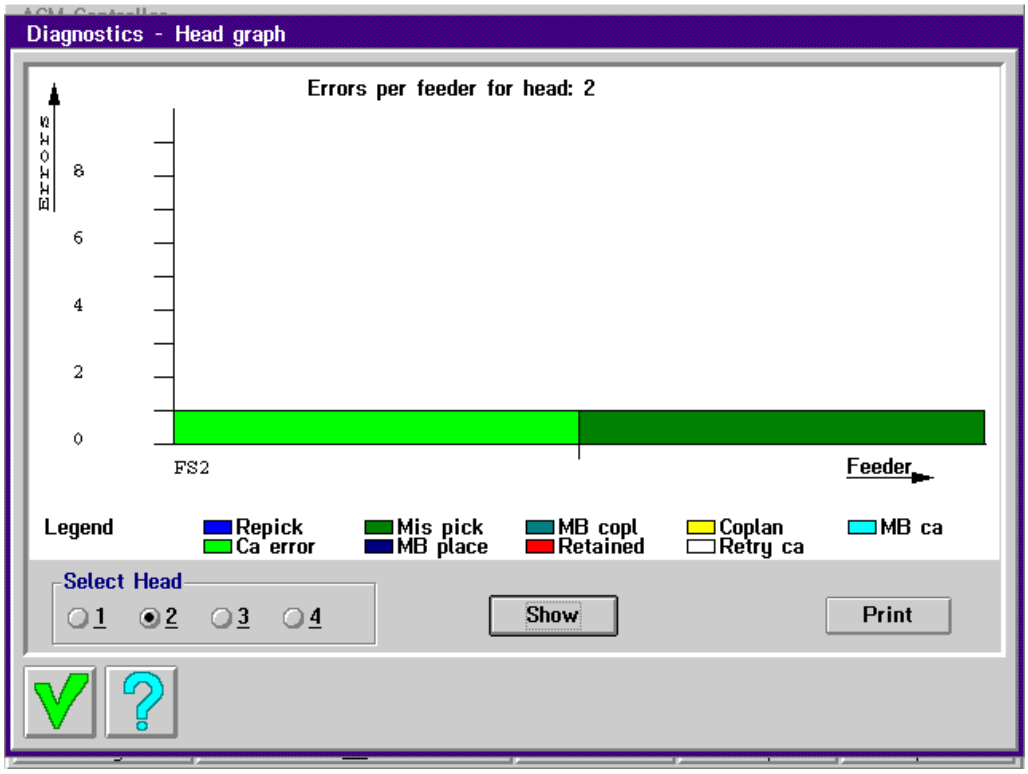

Figure 167 Head 2 Graph

9.2.9 Graphical Report - Feeder

A feeder graph is provided for each feeder section. The process errors and the number of picked components per feeder are shown as stacked bars in barcharts using the same categories as those in the process reports. These are shown as absolute numbers or PPM figures (w.r.t. the number of picked components). The number of picked components are shown as line graphs.

Selecting **<1>** shows a graph (Figure 168) of section 1 for the period [980304]. Selecting **<2>** and then **<Show>** will show the graph for section 2 (Figure 169). The **<Show PPM>** can be selected (Figure 170) and (Figure 171) for each section. The **<Show>** is selected to return to the original graph format.

Selecting **<3>** or **<4>** and then **<Show>** or **<Show PPM>** will do the same for sections 3 and 4.

Selecting **<Print>** will cause the current graph to be printed.

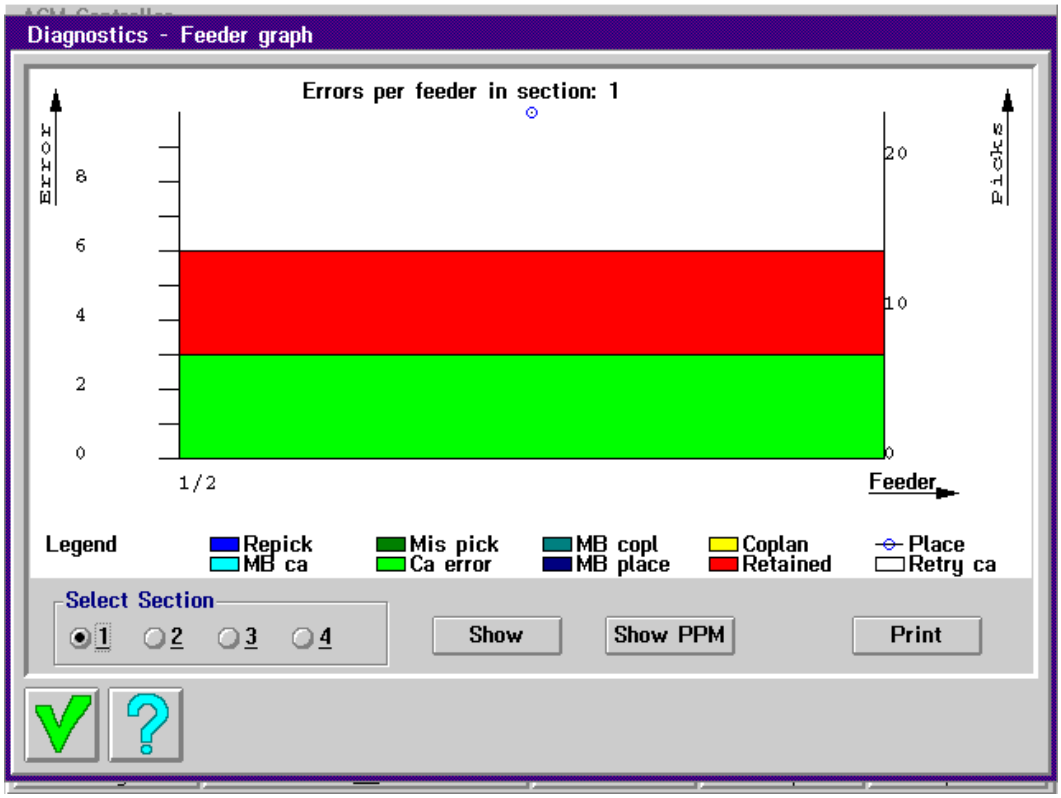

Figure 168 Feeder Section 1 Graph

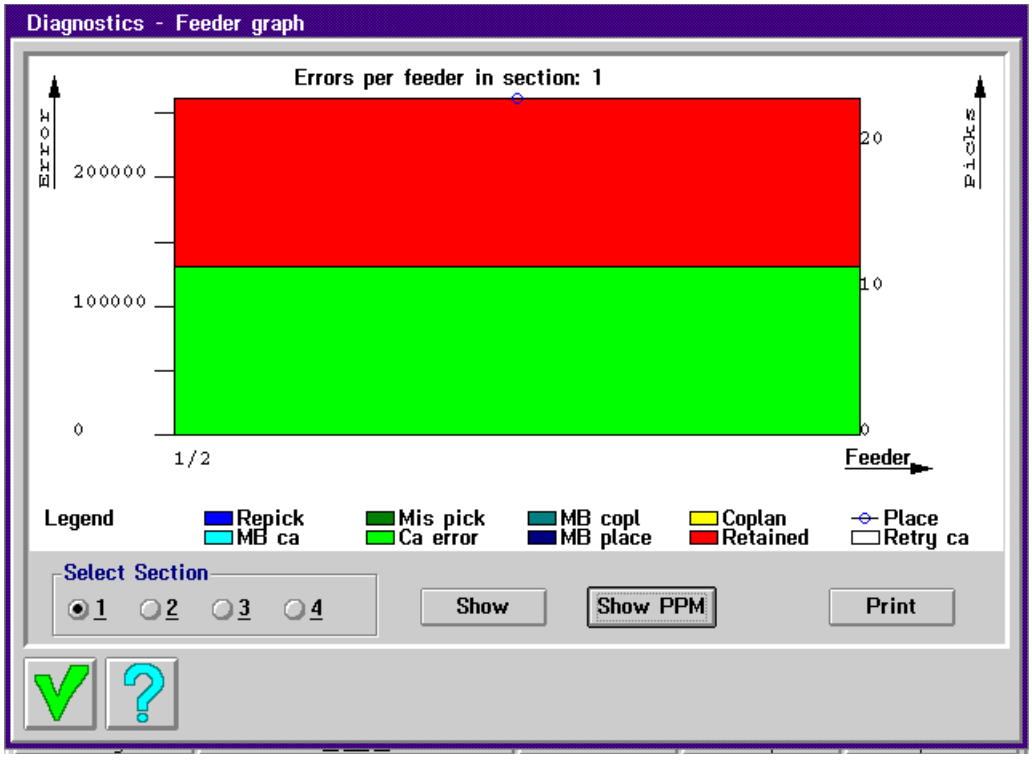

Figure 169 Feeder Section 2 Graph

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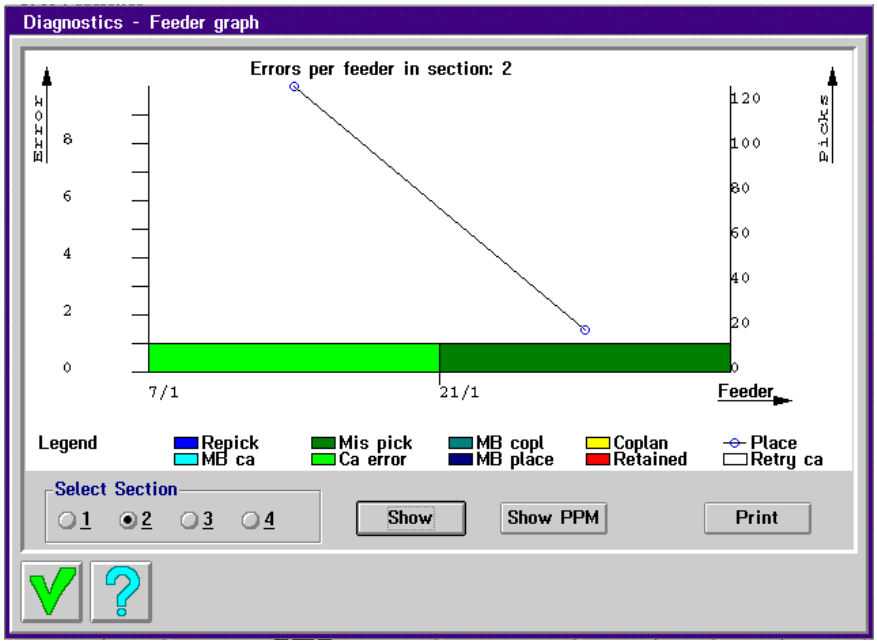

Figure 170 Feeder Section 1 Graph (PPM)

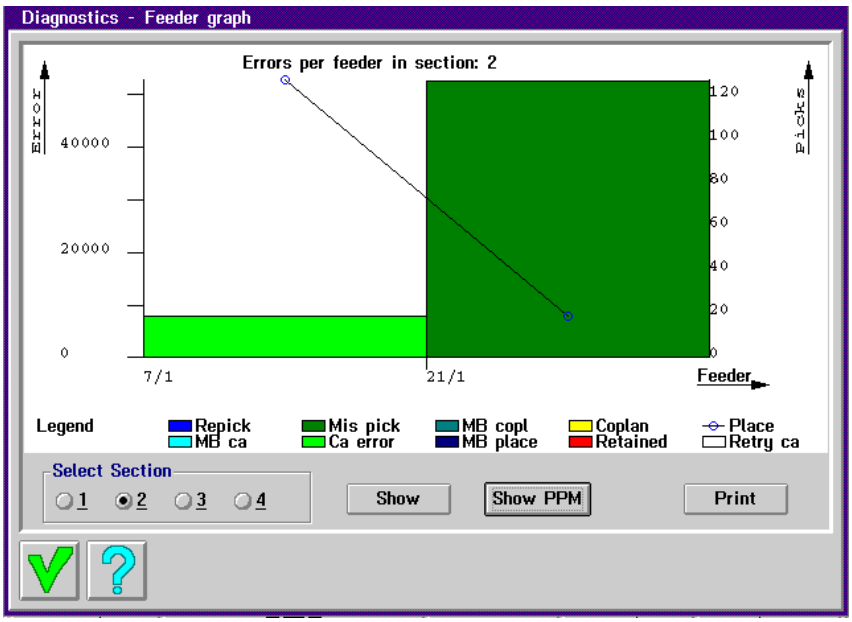

Figure 171 Feeder Section 2 Graph (PPM)

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CHAPTER 10 Troubleshooting

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10.1 Errors and warnings, recognition

A coloured border shown around the alarm button indicates a machine or process malfunction:

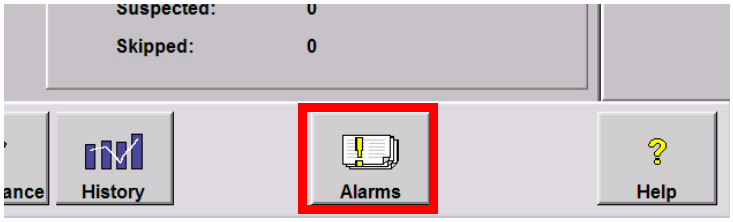

Figure 172 Error indication

- A **red** border indicates an error (1).
  Machine stopped, error has to be solved before production can continue.
  Beeps and **Blue** lamp on lamp post turn on.

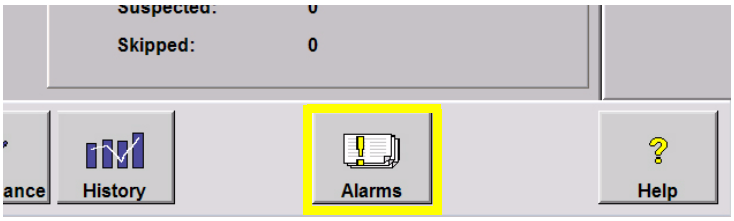

Figure 173 Warning indication

- A **yellow** border indicates a warning (2).
  Machine proceeds, but problem should be solved for optimal operation.

10.2 Display errors

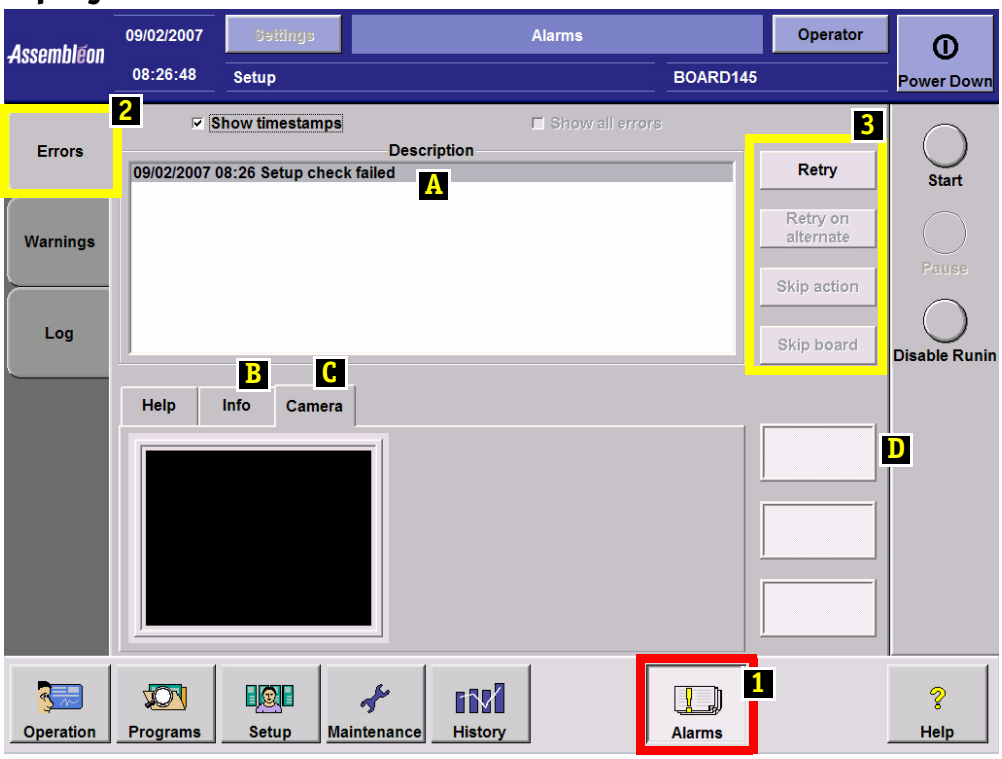

Figure 174 Alarm screen selection

- Select 'Alarms' (1).
- Select 'Errors' (2).
- Use available information on:
  - Error description (A).
  - Help instructions on selected error (B).
  - Camera view related to the error situation (C), see section 10.2.Display errors.
  - Access to recovery actions (D), see section 10.4.1. Diagnostics toolbox.
- Solve the problem on the machine.
  After the problem is solved select one of the options on the right side of the information panel (3):
  - Retry all: retry all displayed errors.
  - Retry: retry the selected error only.
  - Skip action: skip action on module that is related to the selected error.

NOTE: Note that the options that are available depend on the errors that are displayed. Only options that are applicable for the displayed errors are visible.

NOTE: Selecting 'Skip Action' or 'Skip Board' leads to incomplete boards at the run-out. The message:

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• 'Suspected board in Run-out' or
• 'Skipped board in Run-out' appears.
Remove or mark the board.

- After a retry the status of all modules involved is displayed. When an error is not solved, the error screen will continue to display the error. When all errors are solved, production will resume automatically.

10.2.1 Live mode after place error

When the machine detects a place error, the BA camera can be activated (Live mode) to view the feeder and board to diagnose the error:

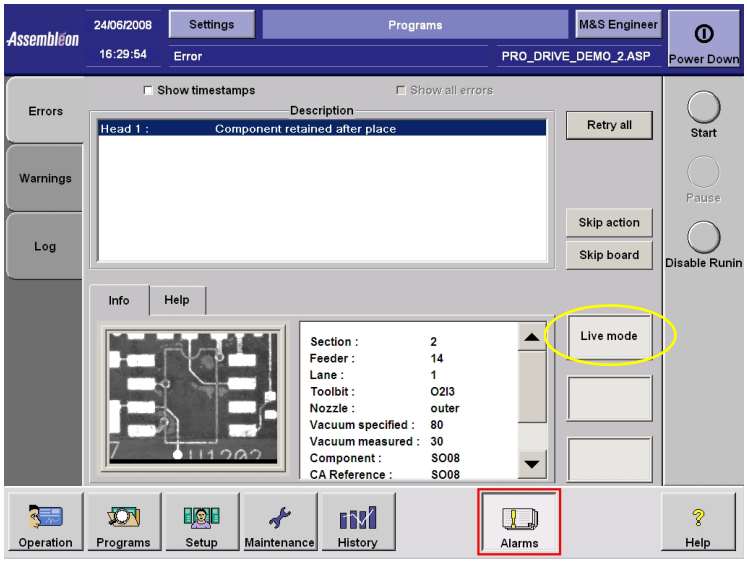

Figure 175

Error screen shows image of place position (after last retry) or board position after place error.

- Activate 'Live mode' , diagnose errors without opening covers.
- Change properties as in 'Teach pick / place'.
- Use changes and/or save changes to running program.

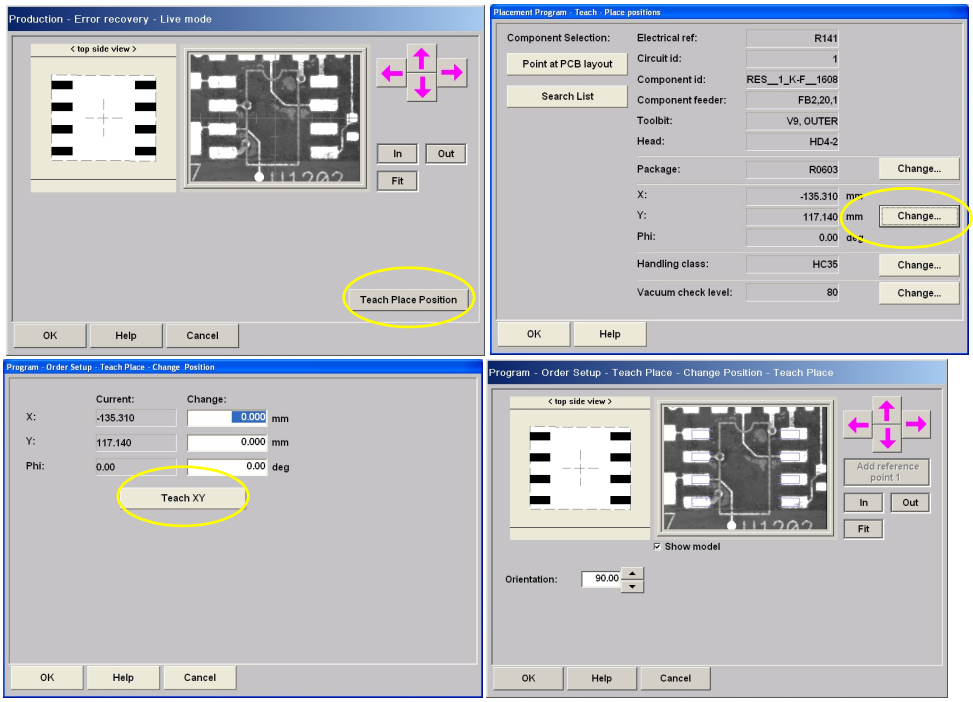

Figure 176

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10.2.2 Live mode after pick error

When the machine detects a pick error, the BA camera can be activated (Live mode) to diagnose the error:

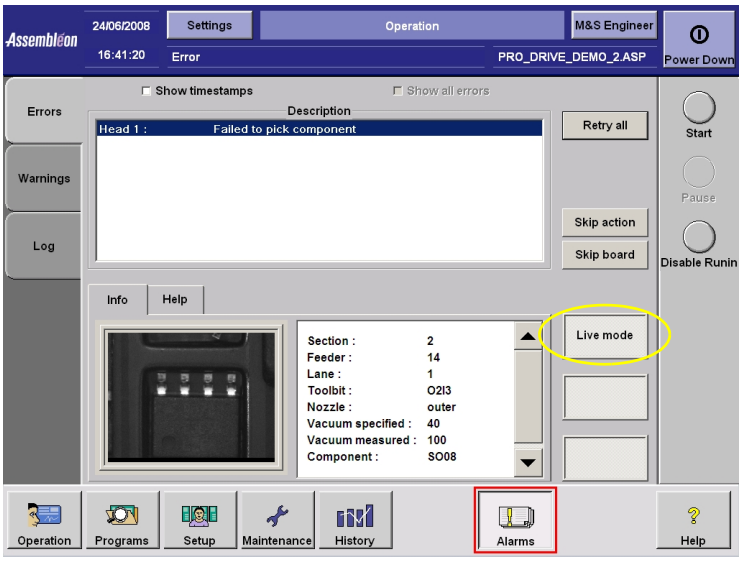

Figure 177

Error screen shows image of pick position (after last retry).

- Activate 'Live mode' , diagnose errors without opening covers.
- Change properties as in 'Teach pick / place'.
- Use changes and/or save changes to running program.

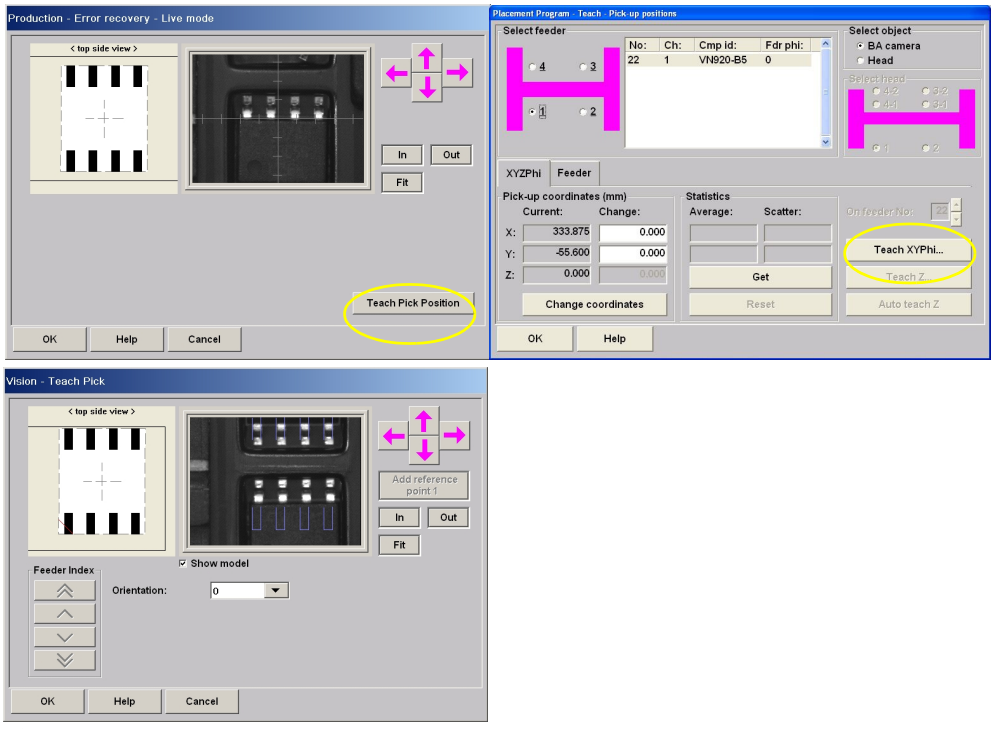

Figure 178

10.3 Display warnings

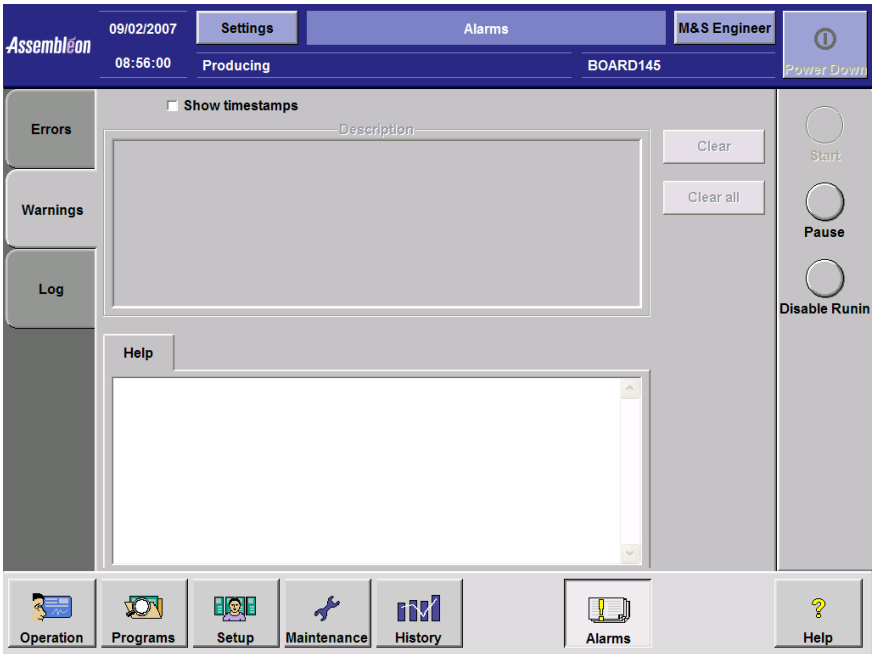

Figure 179

10.4 Error solving procedures

10.4.1 Diagnostics toolbox

Use the diagnostics environment to troubleshoot the error situation in more detail. Access to the diagnostic environment is restricted to qualified and trained personnel of maintenance or service level only.

CHAPTER 11 Options

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7. On/Off button
8. Square opening in squeegee
9. Rotating disk
10. I/O connector to machine
11. Disk speed regulator

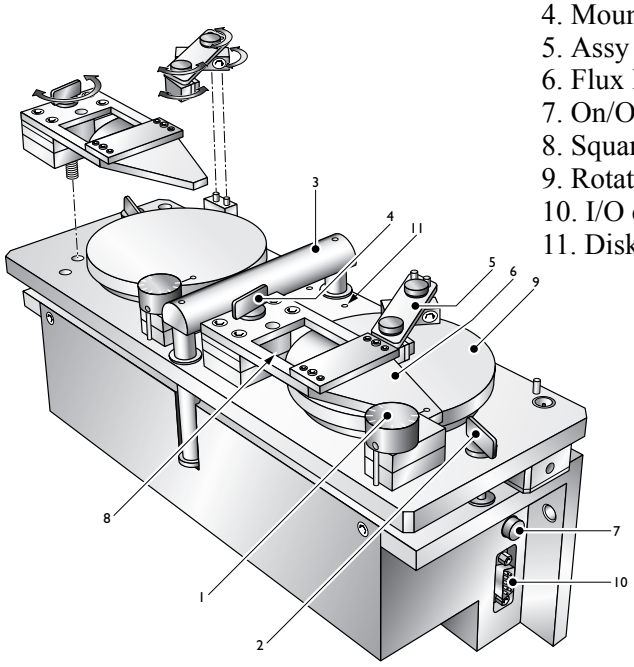


Figure 180 Fluxer

The flux is used to clean the surface to be soldered and to keep the flip-chip in position between placement and soldering.

Components with a bump height ranging from 40 to 220 µm can be handled by the fluxer.

The principle is a metal squeegee mounted over a rotating disk. When the disk turns, a thin layer of flux is spread onto the disk by the squeegee. The speed of the disk is adjustable.

Two wipers gather the flux. The position of the wipers is adjustable. The squeegee keeps the flux moving to assure homogeneity. To control the amount of flux applied to the solderballs of the flip-chip, the disk temporarily stops rotating during dipping.

To avoid dust particles falling into the flux, the Fluxer is provided with a dust cover.

11.1.2 Fluxers, front and rear

There are two types of fluxers:

- The fluxer, rear (PA 2679/00) is used on the rear of the machine Two components can be dipped simultaneously.
- The fluxer, front (PA 2679/10) has the same function as the fluxer rear but is used on the front of the machine and also for pre-processing flux off-line. For this purpose an adaptor set has been assembled for the fluxer, front. So when the fluxer, front is used off-line, it can be mounted on a tabletop with the brackets from the adaptor set.

The fluxer is optional.

NOTE:

11.1.3 Fluxer measuring tool

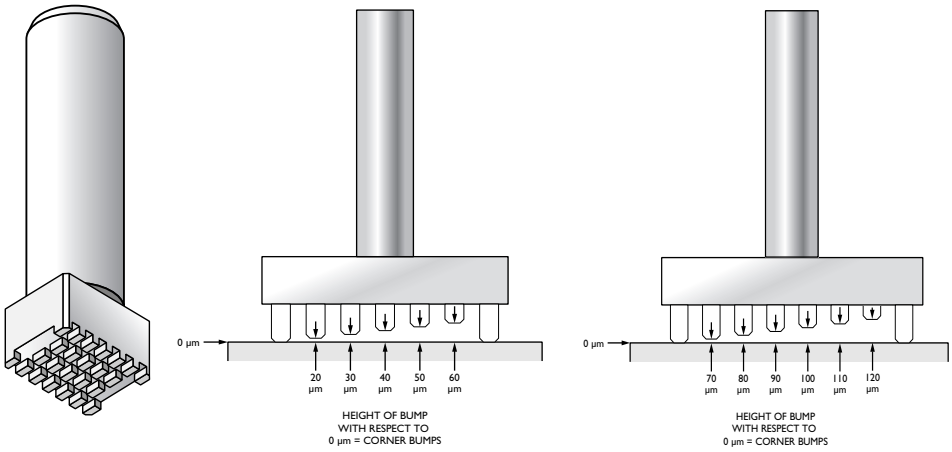


Figure 181 Fluxer measuring tool

The layer thickness of the flux depends not only on the gap between the disk and the squeegee but also on the type of flux used.

Therefore control of the flux layer thickness is necessary. For this two special measuring tools can be used to monitor the real flux layer thickness on the disk. One tool can check from 20 to 60 µm whereas the other one checks from 70 to 120 µm.

The tools are rectangular pieces of hardened steel with reference poles at the corners and a matrix of poles of different lengths in the centre.

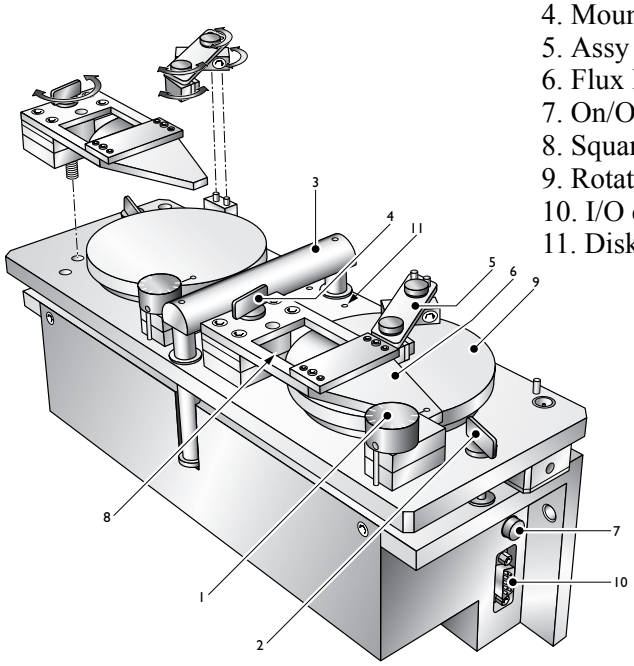
NOTE: Stop the fluxer before measuring the flux layer thickness.

Figure 182

UM-00054.fm

11.1.3.1 Flux layer thickness, adjustment

1. Flux layer height regulator
2. Mounting knob disk unit
3. Carrying handle
4. Mounting knob squeegee
5. Assy wiper fluxer
6. Flux layer height adjustment squeegee
7. On/Off button
8. Square opening in squeegee
9. Rotating disk
10. I/O connector to machine
11. Disk speed regulator



NOTE: Remove at least one trolley before accessing the work-area. This makes for easier access to the work area.

- CAREFULLY remove the cover of the fluxer.
- Place assy wiper fluxer (5) if this has not yet been mounted.
- Adjust the disk speed (11). The default speed of the disk is 10 rpm. Mark the side of the disk with a felt-tip pen and count the number of rotations using a clock.
- Adjust the assy wiper fluxer (5). Adjustment depends on the kind of flux used. The flux should not drip off the disk. Average adjustment is between 30° and 45°.
- Adjust the height of the flux layer height

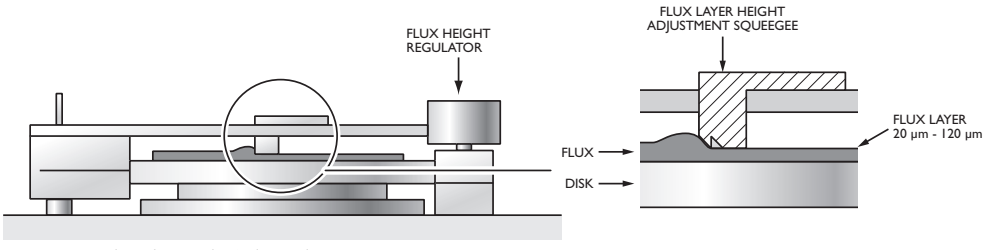


Figure 183 Flux layer height adjustment

- adjustment squeegee in such a way that the thickness of the layer will be between 20 µm and 120 µm by turning the flux layer height regulator (1). Set the flux layer thickness on 50% of the component bump height. Also the quality of the connection may differ depending on the coplanarity of the bumps and pads of board.

- Apply flux on the disk using the square opening in the flux layer height adjustment squeegee unit (see Figure 180).

NOTE: It might be necessary to wear gloves when applying flux. To know if this is the case, check the flux's material safety data sheet for hazardous materials.

- Flux can be applied from a jar, tube or syringe. Let the disk rotate using the On/Off button (see Figure 180). **For the fluxer at the front, the dump-bin should be removed first, otherwise the On/Off button cannot be reached.**
- Watch the flux layer on the disk and fill the empty places gently with more flux. Stop applying flux when the layer on the disk is uniform.
- Take care that flux is only applied to the rotating disk and **NOT** to any other part of the machine.

NOTE: The flux can only be used when its temperature is the same as the ambient temperature (viscosity). Often it will be stored on a colder place. When fresh flux is applied to the disk, it must rotate for some time (max. 1 hour, depending on the type of flux) to avoid that particles in the flux create 'lines' in the flux layer. After this time, the flux layer thickness is stable and will not change during its potlife time. The potlife time of the flux differs per flux type, ranging from approx. 4 to 24 hours. A warning is given when the potlife time has expired. Flux can be refilled when the system has stopped and the cover is opened (refill time is 30 seconds or less). Always clean the fluxer before it is refilled.

- Measure the thickness of the flux layer with the special measuring tool (see Figure 181). To do so, stop the rotation of the disk with the On/Off button (see Figure 180). Dip the measuring tool slightly in the flux layer behind the flux layer height adjustment squeegee (see Figure 180). You can now see which poles touch the flux and so determine the thickness of the flux layer. If necessary, adjust the thickness of the flux layer with the flux layer height regulator (see Figure 180) and apply more flux if necessary.
- If necessary, measure the thickness of the flux layer again with the measuring tool. However, before doing so, clean the measuring tool first. For cleaning details, see Service Manual.

NOTE: Always measure the flux height AFTER the warming-up time!

11.1.4 Fluxer relation to machine configuration and placement program

When a fluxer is configured it must be on, otherwise the machine will not start: Remove the wipers because when there is no flux the wipers will wear out.

For placement program information, see section 7.12.7.Flux.

When the fluxer configured, the maximum board transport width must be limited to 350 mm.

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11.2 Feeder Partner Products

11.2.1 Introduction

At the moment 6 cables are available for auxiliary feeding. The 6 cables are connected to the aPC I/O board. The aPC will be configured with an extra digital I/O board, which creates the possibility to support a total of 12 auxiliary cables. The result will be that, per section, 3 connections are available for auxiliary feeding and for each feeder connected to a cable two inputs and two outputs can be used. Depending on the PC and machine hardware configuration the aPC control software has to support communication with the current aPC I/O board (via three cables) or with the new auxiliary I/O board (via twelve cables). In both cases it should not be necessary to change any feeder files that are currently used.

11.2.2 Stick feeders

The basic stick feeder is specially designed for the system. It is a multilane vibratory stick feeder for several component types. For each component type there is a multilane adaptation set. The adaptation sets are interchangeable. The stick feeders are fully compatible with all systems. The stick feeder has the same interface as the ITF tape feeder and will fit both the feeder trolley and the feeder bank. “US-Vibra” will supply this feeder through the EMT special project path.

11.2.3 Waffle Pack Feeder

The waffle pack feeder provides a good solution for medium to high volume flip chip usage. A stack of 25 waffles at the most can be loaded in the feeder. The first waffle pack is separated from the stack and moved over a belt to the pick position. The system can pick the flip chips out of this waffle pack one by one. After the last flip chip is picked the system will provide a signal to the feeder to exchange the waffle. The empty waffle pack will drop down onto the lower belt and is moved out of the machine into a waste bin where the empty waffle packs are collected for possible reuse. At the same time the next waffle pack is separated from the stack and moved to the pick position. “Laurier Inc.” will supply this feeder through the Assembléon special project path.

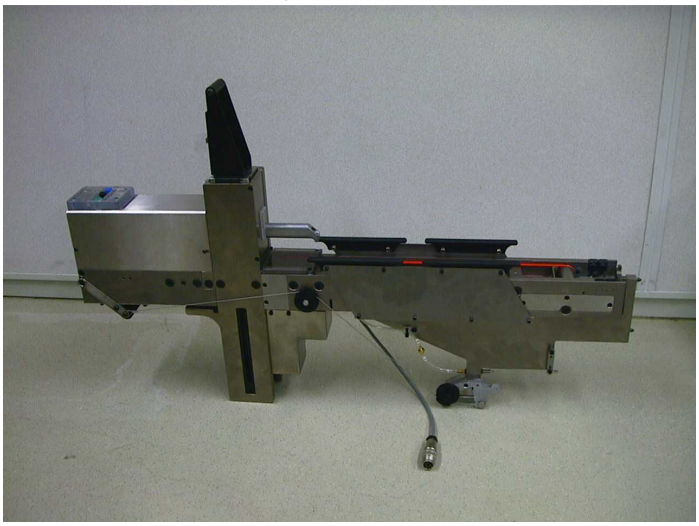

Figure 184 Waffle Pack Feeder

- Controlled feeder (feeder does not index automatically)
- Components in a tray.
- Can be used on a feeder bank and on a feeder trolley.
- Can be used with a normal and a shortened upper guide.
- Connected to the 6 fold auxiliary feeding.
- The following placement positions in a feeder bank or trolley are possible (with matching auxiliary connection):
- The following placement positions in a feeder bank or trolley are possible (with matching auxiliary connection):

Feeder bank/trolley 1							Feeder bank/trolley 2					
Aux cable pos.	Aux 1		Aux 2		Aux 3		Aux 1		Aux 2		Aux 3	
Feeder pos.	3	7	11	15	19	23	3	7	11	15	19	23
Head 1	O	X	X	X	X	X	X	X	X			
Head 2				X	X	X	X	X	X	X	X	O

0 positions cannot be teached with the BA camera.

- Work-around for placement program

The following lines need to be added to an placement program:

[SETUP]

FEEDER record:

- Feeder_bar_nb = feeder section on the system where the waffle pack feeder is located.
- Feeder_nb = Feeder position (see table above)
- Slot_nb = 1
- Feeder_id = WFP_2
- Component_id = id of the component that is placed by the waffle pack feeder.
- Pick_x, pick_y, pick_z = pick position for the feeder depending on the position.

NOTE: Exact pick position needs to be teached.

Feeder bank/trolley						
Feeder pos	3	7	11	15	19	23
pick_x (mm)	-41,3	23,5	88,3	153,1	217,9	282,7
pick_y (mm)	-65,5	-65,5	-65,5	-65,5	-65,5	-65,5

[COMPONENT-TOOLING]

TRAY record:

- Feeder_id= WFP_2
- X_count, Y-count = number of components in x and y direction.
- X_pitch,Y_pitch = pitch in x and y position

Example of placement program:

UM-00054.fm

NOTE: Syntax version is always 3 when you use auxiliary feeding.

```
[GENERAL]
SYNTAX      3
CREATOR     PF
FILE_ID     CT346
LINE_ID     STAR
MACH_ID     TM1
MACH_ADDR1
ISSUEDATE   10-08-2000
ISSUEDATE   16-08-2000
CYCLE_TIME 32.532

[PCB]
PROD_ID     Acc_CT-346
BOARD_DIM   228.6    135.470   1.5

BOARD_ORIGIN   0.00  0.00   0

SIDE    TOP

FIDUCIAL 1 CIRG15CF -5.0  10.00  0
FIDUCIAL 2 CIRG15CF  -5.00  125.470  0
FIDUCIAL 3 CIRG15CF  -223.600  125.470  0

ALIGNMENT 1   1 N  2 N  3 N

COMPONENT 1   1 FC  -204.7     116.7  0 1 0
COMPONENT 1   2 FC  -188.1     116.7  0 1 0
COMPONENT 1   3 FC  -171.5     116.7  0 1 0
COMPONENT 1   4 FC  -154.9     116.7  0 1 0
COMPONENT 1   5 FC  -138.3     116.7  0 1 0
COMPONENT 1   6 FC  -121.7     116.7  0 1 0
COMPONENT 1   7 FC  -204.7     100.1  0 1 0
COMPONENT 1   8 FC  -188.1     100.1  0 1 0
COMPONENT 1   9 FC  -171.5     100.1  0 1 0
COMPONENT 1   10 FC  -154.9    100.1  0 1 0
```

```
[CONFIGURATION]
FA   FA1

HEAD  HD1  IC1
HEAD  HD2  IC1

CA   CA1 SML
CA   CA2 SML

FEEDER_SECTION FB2 FEEDER_TROLLEY

[SETUP]

TOOLBIT O1I3  HD1
TOOLBIT O1I3  HD2

;[bar] [fdr] [slot] [feeder id]  [COMPONENT id] [pick X] [pk Y] [pk Z] [pk Q]
FEEDER FB2   15  1  WFP_2  FC            80.20     -65.5  0  0

[COMPONENT-TOOLING]

COMPONENT FC  DIE-4MM

NOZZLE  FC  O?I3  INNER 1  60  0

;[COMPONENT id] [feeder id][PHI-fdr][X count][Y count][X pitch][Y pitch]
TRAY   FC       WPF_2     0   10  10      4.20     4.20

[ACTION]
FIDUCIAL FA1  1  2  3
PICK   HD1   1   1   FB2   15   1
ALIGN  HD1   1   1   CA1
MOUNT  HD1   1   1
PICK   HD1   1   2   FB2   15   1
ALIGN  HD1   1   2   CA1
MOUNT  HD1   1   2
PICK   HD1   1   3   FB2   15   1
ALIGN  HD1   1   3   CA1
```

```
MOUNT HD1 1 3
PICK HD1 1 4 FB2 15 1
ALIGN HD1 1 4 CA1
MOUNT HD1 1 4
PICK HD1 1 5 FB2 15 1
ALIGN HD1 1 5 CA1
MOUNT HD1 1 5
PICK HD1 1 6 FB2 15 1
ALIGN HD1 1 6 CA1
MOUNT HD1 1 6
PICK HD1 1 7 FB2 15 1
ALIGN HD1 1 7 CA1
MOUNT HD1 1 7
PICK HD1 1 8 FB2 15 1
ALIGN HD1 1 8 CA1
MOUNT HD1 1 8
PICK HD1 1 9 FB2 15 1
ALIGN HD1 1 9 CA1
MOUNT HD1 1 9
PICK HD1 1 10 FB2 15 1
ALIGN HD1 1 10 CA1
MOUNT HD1 1 10
```

11.2.4 Die Eject Feeder

For high to very high volume, tape feeding is the best solution for feeding flip-chips, bare die or other forms of CSPs. Our standard ITF-II tape feeders are used to feed dies in standard embossed tape. Flip chips or bare dies can also be supplied in surftape. This double-sided sticky tape can hold the flip chip or bare die very accurately. The feeder looks like a standard ITF-II feeder but has an additional unit for ejecting the die from the tape.

11.2.5 Direct Die Feeder “Hover-Davis”

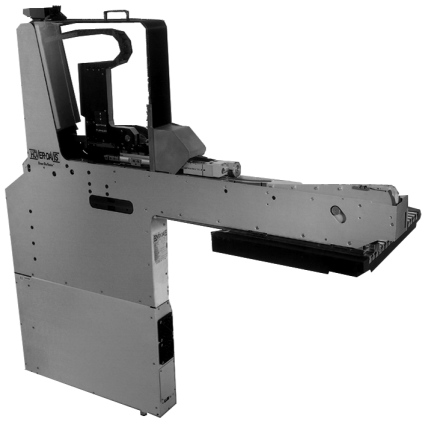

Figure 185 Direct die feeder

Dies can be supplied directly from the wafer to the pick position of the system. This direct wafer feeder picks the die directly from the wafer and puts it on a belt and moves it to the pick position. The die can either be placed on the belt with the connection bumps up (COB) or bumps down (flip chip). The feeder handles a stretched wafer, which can be placed into the feeder from the rear. The feeder will find the position of the wafer by looking at the dies before placing the dies onto the belt. The built-in vision system will also check for badmarks on the die, no faulty dies will be placed onto the belt.

NOTE: This feeder does not yet have the right interface. It is only available with an extra interface block that takes up the space of one feeder section.

11.2.6 Label Feeder “Hover-Davis”

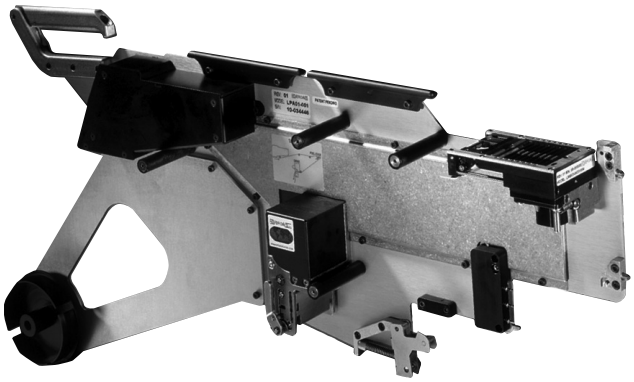

Figure 186 Label feeder

The label feeder can be used to pick and place bar-code or other labels onto a board in the same placement cycle as the standard components.

UM-00054.fm

NOTE: This feeder does not yet have the right interface. It is only available with an extra interface block that takes up the space of one feeder section.

11.2.7 Odd Component Feeder GPAX

The system can very well be used for odd component placement in combination with vacuum nozzles and mechanical feeders. The odd component can be picked from standard embossed tape, tray or stick. Larger odd components can be supplied by the GPAX odd component feeder and the GPAX special tape. The feeder has the system interface and can be placed into a feeder bank
PA 2635/10.

Figure 187 Odd Component Feeder GPAX

- Controlled feeder (feeder does not index automatically).
- For connection procedure please refer to Quick Reference Card 9466 920 05091 GPAX feeder.
- Connected to 6 fold auxiliary feeding.
- Can only be used on a feeder bank.
- Can only be used with a shortened upper guide.
- The following placement positions in the feeder bank are possible (with matching auxiliary connection):

Feeder bank 1						Feeder bank 2			
Aux cable pos.	Aux 1	Aux 2		Aux 3		Aux 1	Aux 2		Aux 3
Feeder pos.	7	11	15	19		7	11	15	19
Head 1	X	X	X	X		X	X	X	X
Head 2			X	X				X	X

Work-around for placement programs

[SETUP] - feeder record:

- Feeder_bar_nb = feeder section on the system where the GPAX feeder is located.
- Feeder_nb = Feeder position (see table below)
- Slot_nb = 1

- Feeder_id = GPAX_72
- Component_id = Component_id = id of the component that is placed by the GPAX feeder.
- Pick_x, pick_y, pick_z = pick position for the feeder depending on the position.

NOTE: Exact pick position needs to be teached.

Feeder bank				
Feeder pos	7	11	15	19
pick_x (mm)	23,5	88,3	153,1	217,9
pick_y (mm)	-65,5	-65,5	-65,5	-65,5

[COMPONENT-TOOLING] - tray record:

- Feeder_id= GPAX_72
- X_count, Y-count = number of components in x and y direction
- X_pitch,Y_pitch = pitch in x and y position

Example of placement program:

NOTE: Syntax version is always 3 when using auxiliary feeding.

```
[GENERAL]
SYNTAX          3
CREATOR         PF
FILE_ID         DEMO
LINE_ID         TAIWAN
MACH_ID         FC
MACH_ADDR       1
ISSUEDATE       19-11-2000
CYCLE_TIME      540
[CONFIGURATION]
FA          FA1
FA          FA2

HEAD          HD1    IC1
HEAD          HD2    IC1

CA          CA1    SML
```

UM-00054.fm

```
CA          CA2    SML
CA          CA3    LRG
CA          CA4    LRG

TEU         TE2

FEEDER_SECTION  FB2    FEEDER_BANK


[SETUP]
; [bar]   [fdr] [slot] [feeder id]  [component id] [pick X] [pick Y] [pick Z] [ pick Q]
FEEDER FB2     11         1         GPAX_72   USB    87.963 -208.847 4.513 0

TOOLBIT       03I1   HD2

[COMPONENT-TOOLING]

COMPONENTUSBUSB

NOZZLE   USB      03I1    OUTER      1       60        0

;   [component id] [feeder id][PHI-fdr][X count][Y count][X pitch][Y pitch]
TRAY  USB   GPAX_72    0    3     1     21     0.00


[PCB]
PROD_ID     DEMO

BOARD_DIM      228.6    135.470   1.5

BOARD_ORIGIN  0.00  0.00   0

BOARD_HEIGHT    0.0       0.0


FIDUCIAL 1 CIRG15CF -5.0  10.00  0
FIDUCIAL 2 CIRG15CF  -5.00  125.470  0
FIDUCIAL 3 CIRG15CF  -223.600  125.470  0
```

```
ALIGNMENT 1  1 N  2 N  3 N


COMPONENT 1 USB1  USB -70.000    60.000    180.000  1        0
COMPONENT 1 USB2  USB -90.000    50.000    180.000  1        0
COMPONENT 1 USB3  USB -120.000   50.000    180.000  1        0
COMPONENT 1 USB4  USB -140.000   60.000    180.000  1        0

[ACTION]

FIDUCIAL  FA1  1  2  3
PICK              HD2          1        USB1     FB2      111
ALIGN             HD2          1        USB1     CA3
MOUNT             HD2          1        USB1

PICK              HD2          1        USB2     FB2      111
ALIGN             HD2          1        USB2     CA3
MOUNT             HD2          1        USB2

PICK              HD2          1        USB3     FB2      111
ALIGN             HD2          1        USB3     CA3
MOUNT             HD2          1        USB3

PICK              HD2          1        USB4     FB2      111
ALIGN             HD2          1        USB4     CA3
MOUNT             HD2          1        USB4
```

11.2.8 Jedec Tray Stack Feeder

Figure 188 Jedec Tray Stack Feeder

- Controlled feeder (feeder does not index automatically).
- Components in a tray (thick and thin JEDEC trays & standard IEC trays).
- Can only be used on a feeder bank.
- Connected to the 6 fold auxiliary feeding.
- For connection procedure please refer to the Quick Reference Card 9466 920 07551 Jedec Tray Stacker.
- The following placement positions in a feeder bank are possible (with matching auxiliary connection):
  - One Jedec Tray Stack feeder on the feeder bank:
    Mount the special top-guide (delivered with the feeder) and place feeder on position 15.
  - Two Jedec Tray Stack feeders on the feeder bank:
    Do not use the top-guide and place the feeders on position 3 and 19.

Work-around for action specs

The following lines need to be added to an placement program:

[SETUP]

FEEDER record:

- Feeder_bar_nb = feeder section on the system where the Jedec Tray Stack feeder is located.
- Feeder_nb = Feeder position (one feeder = position 15, two feeders = position 3 en 19).
- Slot_nb = 1
- Feeder_id = TRAYSTCK
- Component_id= id of the component that is placed by the Jedec Tray Stack feeder.
- Pick_x, pick_y, pick_z = pick position for the feeder depending on the position.

Feeder bank			
Feeder pos	3	15	19
pick_x (mm)	-41,3	153,1	217,9

UM-00054.fm

Feeder bank			
pick_y (mm)	-65,5	-65,5	-65,5

NOTE: Exact pick position needs to be teached.

[COMPONENT-TOOLING]

TRAY record:

- Feeder_id= TRAYSTCK
- X_count, Y-count = number of components in x and y direction.
- X_pitch,Y_pitch = pitch in x and y position

Example of placement program:

NOTE: Syntax version is always 3 when using auxiliary feeding.

```
[GENERAL]
SYNTAX              3
CREATOR             pf
FILE_ID             CT346
LINE_ID             ACM_BY10
MACH_ID             ACMBY10
MACH_ADDR           1
ISSUEDATE           15/03/2001
CYCLE_TIME          100.000

[PCB]

PROD_ID     CT346
BOARD_DIM      228.60  135.47  1.5
BOARD_ORIGIN   0.0     0.0     0
BOARD_HEIGHT    20.0       20.0

FIDUCIAL      1     CIRG15CF  -223.6      10.0        0
FIDUCIAL      2     CIRG15CF  -5          10.0        0
FIDUCIAL      3     CIRG15CF  -5          125.47      0
FIDUCIAL      4     CIRG15CF  -223.60     125.47      0
```

UM-00054.fm

```
ALIGNMENT11 N2 N3 N4S

COMPONENT   2       1       QF208IBH        -380.5  681.0  0      1     0
COMPONENT   2       2       QF208IBH        -380.5  711.0  0      1     0
COMPONENT   2       3       QF208IBH        -380.5  741.0  0      1     0

[CONFIGURATION]

;       fa_nb
FA      FA1

;       head_nb             typ
HEAD    HD1         IC1
HEAD    HD2         IC1

;       ca_nb       typ
CA      CA3                 LRG
CA      CA4                 LRG

;       nb          typ
FEEDER_SECTION  FB2    FEEDER_BANK
[SETUP]
;       tlb_id              hd
TOOLBIT         03I2 HD2

;       fs_nb       fdr         slt         feeder_idcomponent_idpickxyzphi
FEEDER FB2 15 1 TRAYSTCK QF208IBH 20.712 -44.153 5.080 0

[COMPONENT-TOOLING]
;       comp_id     ca_ref
COMPONENT           QF208IBH   QF208IBH

; comp_id    tlb_id     tip_nb    class    check phi     delta x       y    height
NOZZLE   QF208IBH      03I2      OUTER     1   40    0


; comp_id    fdr_id     phi-fdr   x county countx pitchy pitch
TRAY    QF208IBH   TRAYSTCK    90    2 2   37.010   37.010HIGH
```

```
[ACTION]
FIDUCIAL       FA1    1       2       3

PICK     HD2      1       1      FB3     15       1
ALIGN    HD2      1       1      CA4
MOUNT    HD2      1       1

PICK     HD2      2       2      FB3     15       1
ALIGN    HD2      2       2      CA4
MOUNT    HD2      2       2


PICK     HD2      3       3      FB3     15       1
ALIGN    HD2      3       3      CA4
MOUNT    HD2      3       3
```

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